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Ashish Gaur
Editor-in-Chief

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Recommendation Letter

It gives me immense pride to congratulate the editorial team on the launch of the Journal of Indian Physician Associates (JIPA), the official journal of our Association. This milestone reflects the collective vision, perseverance, and dedication of many who believe in the growth of the Physician Associate (PA) profession in India.

JIPA is not just another scientific publication. It is a platform that encourages inclusivity and nurtures a research culture at all levels. A distinctive feature of the journal is the opportunity it creates for students. By welcoming research briefs, case snippets, and personal narratives, it inspires young professionals to engage in academic writing early in their careers. The journal shows that even simple, well-conducted studies can make valuable contributions to healthcare, and that research is not limited to large or ground-breaking discoveries.

Another strength of JIPA is its interprofessional approach. The journal invites submissions not only from PA but also from other healthcare professionals, public health experts, healthcare administrators, and policymakers. By covering areas such as health services, primary care, professional education, and health administration, it highlights that PAs are integral members of a wider healthcare ecosystem rather than working in isolation.

JIPA is hosted on the Digital Commons platform, ensuring international visibility and access. This makes JIPA a valuable resource not only for PAs in India but also for the global community of health professionals who wish to learn from the Indian experience and share their own insights.

On behalf of the Indian Association of Physician Assistants, I warmly congratulate the editorial leadership and everyone who has contributed to this initiative. JIPA is a timely step forward in strengthening the academic foundation of our profession, promoting interprofessional dialogue, and raising awareness about the role of PAs in healthcare delivery.

The journal will serve as a catalyst for students, practicing professionals, and educators who are eager to learn, collaborate, and contribute. It will also play an important role in enhancing recognition of the PA profession in India while advancing the goal of better, evidence-based healthcare for all.

With great pride and best wishes,

Gomathi Sundar
President
Indian Association of Physician Assistants

Recommendation Letter

डॉ॰ यज्ञा उन्मेष शुक्ला, *(पीएच.डी)*
अध्यक्ष, एन सी ए एच पी

Dr.Yagna Unmesh Shukla,(Ph.D)
Chairperson, NCAHP

सत्यमेव जयते

राष्ट्रीय सहबद्ध और स्वास्थ्य
देख–रेख वृत्ति आयोग
स्वास्थ्य एवं परिवार कल्याण मंत्रालय
भारत सरकार
Government of India
Ministry of Health & Family Welfare
National Commission
for Allied and Healthcare Professions

Message

It gives me immense pleasure to extend my heartfelt congratulations to the editorial team and contributors on the launch of the **Journal of Indian Physician Associates (JIPA)** a pioneering initiative that marks a significant milestone in the academic and professional journey of Physician Associates across India.

The formalization of the curriculum for Physician Associates under the NCAHP framework represents a transformative step towards standardizing education, enhancing professional recognition and ensuring the highest standards of practice in this vital cadre of healthcare providers. The introduction of JIPA, a peer-reviewed scientific platform, further reinforces this vision by offering a dedicated space for scholarly discourse, evidence-based research and interdisciplinary collaboration.

At a time when healthcare systems are becoming increasingly integrated and team-based, the role of Physician Associates is more crucial than ever. Through JIPA, the PA community now has a voice one that can shape policy, contribute to medical literature and promote best practices not just within India, but globally.

I commend this initiative for its inclusive approach and commitment to academic excellence. Hosting the journal on a globally accessible platform like Elsevier's Digital Commons is a testament to the team's foresight in promoting international engagement and visibility.

May JIPA serve as a beacon for scientific innovation, professional empowerment and continual learning. I extend my best wishes for its successful launch and sustained impact in the years to come.

With best wishes,

Dr. Yagna Unmesh Shukla(PhD)
Chairperson (NCAHP)
National Commission of Allied & Healthcare Professions,
Ministry of Health & Family Welfare,
New Delhi.

Recommendation Letter

University of Lynchburg

School of Medicine and Health Sciences

Introduction to the *Journal of Indian Physician Associates*

It is with profound respect and appreciation that I have the honor to announce the launch of a new scholarly resource aimed at medical professionals: the *Journal of Indian Physician Associates (JIPA).* The publication of this inaugural issue marks a significant milestone for the Indian Medical Community, representing an important venture with the potential to advance the Physician Associate (PA) profession both within India and on a global scale.

Having had the privilege to collaborate with the *JIPA* editorial team during the development of this publication, I commend their initiative in establishing a new scientific medical journal dedicated to the PA community, and helping PAs to provide authoritative, evidence-based healthcare. *JIPA*, published biannually, is committed to serving physician associates and public health professionals worldwide. The journal's mission is to provide an inclusive platform that fosters research and innovation and supports the global exchange of scholarly ideas. *JIPA's* content will be hosted on Digital Commons by Elsevier, ensuring that its articles and research reach a broad, international audience of scholars and practitioners.

Congratulations are extended to Ashish Gaur, Editor-In-Chief of JIPA, and Dr. Tanmay Acharia, co-Editor-in-Chief, whose vision and perseverance have been instrumental in bringing this timely initiative to fruition.

Thomas Colletti, DHSc, MPAS, PA-C Emeritus, DFAAPA
Professor, Doctor of Medical Science
School of Medicine and Health Sciences
University of Lynchburg

Recommendation Letter

University of Lynchburg

To the Editorial Team of the Journal of Indian Physician Associates (JIPA),

I extend my heartfelt congratulations to you on the successful launch of the *Journal of Indian Physician Associates*. This initiative marks a significant milestone not only for the PA community in India but for the global advancement of physician associate scholarship and professional identity.

The establishment of a peer-reviewed scientific journal dedicated to the PA profession is a bold and commendable step—one that reflects vision, leadership, and a deep commitment to academic excellence. By creating a platform for clinical research, professional discourse, and interdisciplinary collaboration, JIPA is poised to elevate the visibility and credibility of PAs within the broader medical community.

As a healthcare leader and academic deeply engaged in the evolution of PA education and practice, I applaud your efforts to foster a culture of inquiry and evidence-based care. The journal will undoubtedly serve as a catalyst for innovation, advocacy, and global engagement, inspiring current and future generations of physician associates to contribute meaningfully to the advancement of medicine.

Please accept my sincere appreciation for your dedication to this endeavor. I look forward to following JIPA's growth and impact in the years ahead.

Warm regards,
James R. Kilgore

James R. Kilgore, DMSc, PhD, PA-C, DFAAPA
Associate Professor
Co-Editor-In-Chief, Journal of Medical Science
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Recommendation Letter

Ashish Gaur
Editor-in-Chief, JIPA
Indian Association of Physician Associates

Dear Ashish,

It is with great pride and admiration that I extend my heartfelt congratulations to you and the entire editorial team on the launch of the *Journal of Indian Physician Associates (JIPA)*. This inaugural issue represents a landmark achievement for the Indian PA community and a bold step forward in advancing the profession through academic scholarship and clinical excellence.

The creation of a dedicated scientific medical journal is a testament to the vision, commitment, and growing influence of Physician Associates in India. JIPA will serve as a vital platform for disseminating research, sharing clinical insights, and fostering professional dialogue for PA education and practice across the country.

This milestone also reflects the deepening collaboration between the Indian Association of Physician Associates (IAPA) and the International Academy of Physician Associate Educators (IAPAE). The 14th Annual IAPAE Conference, held in Gandhinagar, India, was a powerful demonstration of this partnership, with IAPA board members actively participating and contributing to the global discourse on PA education. It was during this conference that IAPAE proudly supported the establishment of the India PA Academic Forum, an initiative that will further empower Indian PAs to engage in academic leadership and scholarly activity.

Your leadership in launching JIPA, alongside the collective efforts of the editorial board and the broader IAPA community, is truly commendable. IAPAE remains committed to supporting this journey and celebrating the achievements of our colleagues in India.

On behalf of IAPAE, I offer my warmest congratulations and continued support. May JIPA inspire innovation, elevate standards, and amplify the voice of the PA profession, both within India and on the global stage.

With sincere appreciation and best wishes,

Scott Smalley, PA-C
Immediate Past President
International Academy of Physician Associate Educators (IAPAE)

Recommendation Letter

Message from the President of GACOPA

On behalf of the Global Association of Clinical Officers and Physician Associates (GACOPA), I extend our warmest congratulations to the Editorial Board of the Journal of Indian Physician Associates (JIPA) on the official launch of this important publication.

The journey to this milestone has been marked by dedication, vision, and collaboration, and we are proud to have walked alongside JIPA in its formative stages. My own appointment to the International Veritas Council of the journal was not just a personal honor, but also a reflection of GACOPA's shared commitment to advancing research, scholarship, and international cooperation in our profession.

As we gather in Chennai for IAPACON and the formal launch of JIPA, I wish to reaffirm GACOPA's full support. We will continue to embrace this journal across all our networks, encouraging contributions from Africa, Asia, Europe, Americas and beyond, to ensure it grows into a truly international platform of scientific exchange.

This launch is more than the beginning of a journal—it is the strengthening of a professional voice that will serve generations to come. GACOPA celebrates this achievement and looks forward to collaborating closely with JIPA in building bridges of knowledge and solidarity across the globe.

Austin Oduor Otieno
President, GACOPA

Austin Oduor Otieno
Deputy Secretary - Kenya Union of Clinical Officers
President - Global Association of Clinical Officers and Physician Associates/president@gacopa.org
Founder - Sokafrika.com/info@sokafrika.com

Recommendation Letter

David J. Bunnell
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It is with great enthusiasm that I extend my heartfelt congratulations to the editorial team of the *Journal of Indian Physician Associates (JIPA)* on its inaugural issue. The launch of this biannual, peer-reviewed journal marks a significant milestone for the physician associate profession in India and globally.

Creating a dedicated platform for research, scholarship, and innovation within the PA community is more than an academic achievement. It demonstrates the profession's commitment to advancing patient care through evidence-based practice and global collaboration. By fostering the exchange of ideas across borders, disciplines, and healthcare systems, JIPA has the potential to inspire new approaches to care delivery, promote professional growth, and strengthen the voice of PAs in the global health dialogue.

India is rapidly emerging as a leader in healthcare innovation. The launch of JIPA reflects the nation's growing influence in shaping global health solutions. This journal will showcase research originating from India and provide a platform for international collaboration, ensuring diverse perspectives and shared learning.

As we continue to address the complex challenges of modern healthcare, the importance of rigorous, peer-reviewed research cannot be overstated. I commend the JIPA editorial team for their vision and dedication in creating a journal that will both document our profession's progress and help shape its future. I look forward to seeing JIPA's contributions to the growing body of knowledge that informs PA practice worldwide. I am confident this publication will become a respected resource for clinicians, educators, researchers, and policymakers.

Congratulations once again to everyone involved in bringing JIPA to life. Your work will inspire current and future generations of physician associates to lead, innovate, and advocate for the highest standards of patient care.

Sincerely,

David J. Bunnell
PhD, MSHS, PA-C, DFAAPA

President-elect
American Academy of Physician Associates

Assistant Professor
University of Maryland School of Graduate Studies

Recommendation Letter

From the Desk of David E. Lizotte, Jr.

It is with great pride and enthusiasm that I congratulate the editorial team on the inaugural launch of the Journal of Indian Physician Associates (JIPA). This achievement marks a historic milestone for our profession—one that will resonate not only within the PA community but across the broader spectrum of health care and academia.

The establishment of JIPA signals a bold step forward in the continued growth and recognition of the physician assistant profession worldwide. A dedicated, peer-reviewed scientific journal elevates our collective voice, reinforces our commitment to evidence-based practice, and provides an indispensable platform for advancing clinical knowledge, scholarship, and innovation in patient care.

For decades, physician assistants have contributed profoundly to the accessibility, quality, and efficiency of health care across diverse settings. With JIPA, we now affirm that the expertise and insight of PAs deserve to be captured, disseminated, and built upon for generations to come. Importantly, this initiative underscores that our profession is not only a vital part of the clinical workforce but also a driving force in shaping the research and ideas that define modern medicine.

I commend the vision, dedication, and leadership of the JIPA editorial team in undertaking this initiative. Launching a professional journal is no small task—it is an enduring commitment to rigor, integrity, and the advancement of knowledge. Your work stands as a testament to what is possible when passion and purpose converge.

I urge members of the PA community and our colleagues across health disciplines to embrace this journal as a shared space for collaboration, inquiry, and progress. Together, we can ensure that JIPA becomes a trusted resource and a catalyst for elevating the role of physician assistants globally.

Congratulations on this important achievement. The birth of JIPA represents not just a new publication, but the beginning of a new chapter in the history of the PA profession.

With admiration and support,

David E. Lizotte, Jr. MPAS. PA-C

From the Editor's Desk

It is with immense pride and gratitude that I welcome you to the inaugural edition of the **Journal of Indian Physician Associates (JIPA)**.

This moment is the culmination of a long-held vision to establish a premier platform for the academic and professional advancement of physician associates, not just in India, but across the globe.

Our journey began in October 2024, a path made possible by the unwavering support and trust of Ms. Gomathi, **President of the Indian Association of Physician Assistants** (IAPA). Her vision to empower us to work independently on this monumental task was the catalyst that brought this idea to life. We recognized early on the need for a journal of this stature and the importance of assembling the right talent to bring it to fruition. The backend work was immense, involving countless Zoom meetings with eminent international faculty members, including presidents of PA societies worldwide. These dialogues were critical in building our quorum and finalizing a robust plan.

We took great care in framing the bylaws of JIPA, ensuring they are ethically, legally, and morally sound, designed to stand the test of time. A critical component of this was establishing a fallback mechanism to sustain a steady flow of manuscripts. Our financial planning, a result of numerous meetings with legal and financial experts in the publishing industry, has laid the groundwork for a self-sustaining journal. We are also honored to have formed the **International Veritas Council**, a think tank of global leaders and subject experts who will provide the neurological framework to our cohesive work, helping us generate fresh ideas. To foster a new generation of researchers, we also established a separate **student editorial board - National & International Wing** to encourage early engagement and submissions.

We extend our deepest gratitude to **Dr. James R. Kilgore, Dr. Thomas Colletti, and Dr. Jenna Rolfs** for their invaluable assistance in initiating our dialogue with **Digital Commons-Elsevier**. This collaboration has provided us with a unique and sophisticated platform for manuscript submissions and peer reviews, which is a crucial step toward our goal of being indexed in major databases.

Over the past five to six months, we have organized monthly Zoom talks to ignite interest in scientific writing and submission, and the response has been truly encouraging. We received 21 manuscripts, and I am thrilled to announce that our first edition, launching this October, will feature 9 of these remarkable works.

The purpose of launching JIPA is to cultivate a culture of scientific writing and academic inquiry within the PA fraternity. The journal's sustenance depends on the enthusiasm of PAs in submitting their scientific work and the tireless efforts of our editorial team in guiding these manuscripts through the publication process. I sincerely hope that the Indian and global PA community will embrace and support JIPA as their own, promoting it widely to ensure its continued success.

Our Vision

The Journal of Indian Physician Associates (JIPA) is committed to being a premier, peer-reviewed, double blinded medical and healthcare journal. Our primary aim is to be a platform for the academic and professional growth of physician associates in India while remaining inclusive of the global PA community. We invite healthcare, primary care, and public health professionals to contribute original research, clinical insights, and scholarly dialogue.

JIPA is more than just a journal; it's a testament to the power of a shared vision and collaborative effort. It's an intellectual home for our community, a place where ideas are born, debated, and refined. I look forward to witnessing the impact of your contributions on the future of our profession.

Sincerely,

Ashish Gaur
Editor-in-Chief
Journal of Indian Physician Associates (JIPA)
Senior Surgical Associate/Senior Manager
Department of Heart Transplants & Adv Cardiac Surgery
Sir HN Reliance Hospital, Mumbai

From the Co-Editor's Desk

Launch of the Journal of Indian Physician Associates (JIPA)

It gives me immense pleasure to announce the launch of the *Journal of Indian Physician Associates (JIPA)*, a milestone that coincides with the celebration of International Physician Associate (PA) Week. This convergence is both symbolic and meaningful — as the global PA community celebrates its contributions to patient care, innovation, and inter-professional collaboration, we in India mark the beginning of a new chapter in academic and professional growth for our own Physician Associate fraternity.

The *Journal of Indian Physician Associates* represents the first dedicated scholarly platform for Physician Associates in India. It has been conceived with the vision of advancing education, research, and clinical practice within this evolving profession. As our healthcare landscape becomes increasingly complex and interdisciplinary, the need for evidence-based practice, clinical scholarship, and academic discourse among PAs has never been greater. JIPA seeks to bridge this gap — fostering a culture of research, encouraging clinical inquiry, and showcasing the breadth of expertise that Indian PAs bring to patient care across diverse medical and surgical specialties.

The timing of JIPA's launch during International PA Week highlights our alignment with the global PA movement — one that champions accessible, high-quality, team-based healthcare. This year's PA Week is a celebration not only of what PAs do but also of what they stand for: commitment, competence, and compassion. In the same spirit, JIPA aims to be more than a publication — it is a voice for Indian PAs to share their experiences, innovations, and research with peers across the world.

Through original research, clinical reviews, case reports, and educational commentaries, JIPA will serve as a repository of knowledge and reflection. Our mission is to promote scholarly excellence, enhance professional recognition, and contribute meaningfully to the discourse on allied and healthcare professions in India. We are equally committed to inclusivity — inviting contributions not only from PAs but also from physicians, educators, and allied health professionals who share our vision for collaborative care.

The establishment of JIPA has been made possible through the dedication and collective effort of the Indian Association of Physician Assistants (IAPA) and its editorial team. We extend our sincere gratitude to our advisors, reviewers, and contributors whose support has transformed this vision into reality. Hosted on the Digital Commons platform through the University of Lynchburg, and supported by Elsevier, JIPA embodies both academic rigor and international accessibility.

As we unveil the inaugural issue, we invite readers to explore, engage, and contribute. Each article is a reflection of the growing maturity of the PA profession in India — a profession defined by service, learning, and leadership.

Let this launch during International PA Week remind us that while our challenges are unique, our aspirations are shared — to deliver better healthcare, driven by knowledge, compassion, and collaboration.

Together, through *JIPA*, we celebrate the present and shape the future of the Physician Associate profession in India.

Sincerely,

Dr. Tanmay Acharia, DMSc
Co-Editor in Chief
Journal of Indian Physician Associates (JIPA)
Senior Surgical Associate/Team Leader
Department of Cardiac Surgery
Fortis Hospital, Kolkata

Assessing the Impact: Cerebral Palsy on Domains of Quality of Life

Sheetal Malhan[a], Mohd. Tabish[b], and Kanak Singh[c]

Abstract

Introduction Cerebral palsy (CP) is characterized by a group of permanent movement and posture disorders resulting from nonprogressive disturbances in the developing fetal or infant brain. CP is a chronic condition affecting approximately 1.2–2.5 per 1000 school-aged children, often accompanied by comorbidities such as visual, auditory, and feeding impairments, delayed language development, and epilepsy. These related challenges can markedly reduce a child's quality of life (QoL), particularly when compounded by social and environmental limitations. Despite the importance of understanding QoL outcomes in this population, limited region-specific data exist. Understanding domain-specific QoL can guide targeted rehabilitation planning.

Methods A cross-sectional survey was conducted at a special school in North India. Thirteen children aged 4–12 years diagnosed with CP participated in the study based on defined inclusion and exclusion criteria. Primary carers completed the Cerebral Palsy Quality of Life Questionnaire for Children (Parent Proxy version) after providing informed consent. This questionnaire assesses seven QoL domains: social well-being and acceptance, feelings about functioning, participation and physical health, emotional well-being and self-esteem, access to services, pain and impact of disability, and family health. Scores were normalized to a 0–100 scale. Descriptive statistics were calculated to assess differences by age and gender.

Results The mean age of participants was 9.92 ± 1.72 years, with 69.2% being male. The domain scores were highest in social well-being and acceptance (71.02 ± 10.80) and emotional well-being (68.33 ± 17.12), whereas the lowest scores were found in participation and physical health (52.26 ± 16.57) and family health (68.75 ± 20.39). Male children reported higher QoL in most domains, whereas female participants reported higher scores in family health and access to services. The small sample size limited statistical significance across demographic subgroups.

Conclusion Children with CP showed better QoL in social and emotional domains but lower scores in physical participation and family health. These findings limit the importance of inclusive education and family-centered interventions. Larger and more varied samples are needed in future research to enhance the generalizability of results. Integration of rehabilitation services tailored to family-centered care could play a major role in improving QoL outcomes.

Keywords cerebral palsy, quality of life, CP QOL-Child, carer-reported outcomes, pediatric disability, rehabilitation

Introduction

Cerebral palsy (CP) is characterized by a group of permanent disorders of movement and posture attributed to non-progressive disturbances in the developing fetal or infant brain. This major cause of childhood physical disability has a prevalence ranging from 1.2 to 2.5 per 1000 school-aged children. The motor impairments seen in CP are typically classified into subtypes such as spastic, dyskinetic, hypotonic, or mixed types. In addition to movement disorders, children with CP frequently experience associated conditions including visual and auditory impairments, feeding difficulties, delayed language development, cognitive limitations, and epilepsy. These comorbidities can significantly affect daily functions and overall quality of life (QoL) of children with CP.[1]

Research highlights that children with CP often have lower psychological and functional QoL in comparison to their typically developing peers.[2] While some studies indicate a weak correlation between functional limitations and psychological QoL, others report that reduced participation in social and physical activities, due to both medical and environmental barriers, contributes to a decline in QoL over time.[3] Although the condition itself is non-progressive, it can have a lasting impact on functional ability of the child, often leading to increased dependence and reduced autonomy in daily life.[4]

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The authors declare no conflicts of interest related to this article.
No external funding was received for this work.

The concept of QoL is complex and multifaceted in children with disabilities such as CP. It encompasses physical, emotional, social, and family domains, making it an important outcome measure in pediatric rehabilitation and public health. However, QoL is not always directly proportional to the extent of motor impairment; some children exhibiting severe limitations in functions report good QoL, while others with milder symptoms may experience psychological distress and reduced social participation.[5]

To overcome this complexity, condition-specific tools such as the Cerebral Palsy Quality of Life Questionnaire for Children (CP QOL-Child) have been developed.[6] The Parent Proxy version of the CP QOL-Child, designed for children aged 4–12 years, includes 65 items distributed across seven domains: (1) social well-being and acceptance, (2) participation and physical health, (3) feelings about functioning, (4) emotional well-being and self-esteem, (5) access to services, (6) pain and impact of disability, and (7) family health. Each item is rated on a 9-point scale (1 = very unhappy to 9 = very happy), and scores are transformed to a 0–100 scale for consistency in interpretation.[6]

Previous studies using the CP QOL-Child have shown that while domains like social acceptance and participation tend to score relatively high, areas such as emotional well-being, family health, and access to services often reveal deficits.[7] Internal consistencies for some domains (eg, social well-being, participation) have been reported to be strong (Cronbach's $\alpha > 0.7$), whereas others such as pain and family health display lower reliability.[7]

A European multicenter study by Arnaud et al[8] involving over 800 children with CP highlighted that QoL scores did not always coincide with the level of physical impairment. Similarly, McManus et al[9] emphasized that functional limitations alone do not determine QoL outcomes in children aged 8–12 years. These findings underline the importance of measuring QoL as a distinct construct, rather than assuming that it correlates directly with motor function.

Understanding the multidimensional impact of CP on QoL is necessary not only for clinical prognosis but also for formulating effective rehabilitation strategies. QoL assessments lead to critical insights into the child's physical, emotional, and social challenges, thus allowing health professionals to tailor interventions that go beyond motor function improvement. Family education, access to services, and psychosocial support can be optimized when guided by domain-specific QoL data, ultimately improving long-term functional outcomes and satisfaction with care.[10]

Objective of the Study

The primary objective of this study is to assess the impact of CP on different domains of QoL in children aged 4–12 years using the CP QOL-Child (Parent Proxy version). The aim is to ascertain specific areas of strength and limitation in QoL among children with CP in order to provide more focused and comprehensive rehabilitation strategies.

Need for the Study

In addition to the motor functions, CP affects social interaction, communication, cognition, and behavior. The resultant constraints in activity and social involvement can lower the QoL. To have a better understanding of the factors influencing the QoL, it is essential to assess these diverse implications. The insights gained from such evaluations aim to improve involvement, autonomy, and well-being.

Materials and Methods

Study Design and Setting

A cross-sectional, observational study was conducted at a special school for children with disabilities in North India. The study sought to evaluate the QoL of children with CP using a validated questionnaire. In compliance with the ethical norms for research involving human subjects, the Institutional Ethics Committee granted ethical approval, and all participants' primary carers signed the informed consent.[11]

Participants

Eligibility was assessed for the participants, i.e., children with a confirmed diagnosis of CP in the age range of 4–12 years and a primary carer who could comprehend and complete the questionnaire. Children with comorbidities, progressive neurological conditions, or uncooperative carers were excluded from the study.

Thirteen out of 64 children screened were found to be eligible for the study. Although the study is of an exploratory nature, aimed at gaining insights into domain-specific QoL trends in the North Indian setting, the small sample size is a limiting factor.

The CP QOL-Child (Parent Proxy version) is a tool specifically designed to evaluate the QoL of children with CP aged 4–12 years. It has 65 items in seven different domains:

1. social well-being and acceptance;
2. participation and physical health;
3. feelings about functioning;
4. emotional well-being and self-esteem;
5. access to services;
6. pain and impact of disability; and
7. family health.

On a 9-point Likert scale, 1 represents very unhappy and 9 represents very happy. Certain items, such as those related to pain, are reverse scored. For standardization, all the responses are converted to a 0–100 scale, where higher scores denote higher perceived QoL.[6,12]

The tool has shown good internal consistency in several domains (Cronbach's $\alpha > 0.7$), although some domains, such as emotional well-being and family health, exhibit lower reliability scores.[7,12] In this study, the questionnaire was given to carers in person after clear verbal instructions in simple language. Means and standard deviations were calculated for age and gender subgroups.

Data Analysis

Descriptive statistics (mean and standard deviation) were calculated for each of the seven QoL domains. SPSS version 20.0 (IBM Corp., Armonk, NY, USA) was used to analyze the association between age, gender, and domain scores. No inferential claims were made, and the results were interpreted cautiously due to the small sample size.[9,13]

Results

The total number of participants was 13 children with diagnosed CP. Of these, 9 (69.2%) were males and 4 (30.8%) were females. The participants were grouped by age into two categories: 4–8 years (n = 3; 23.1%) and 9–12 years (n = 10; 76.9%). The mean age of the participants was 9.92 ± 1.72 years.

The distribution of age and gender of the participants is depicted in Table 1.

Domain-wise QoL scores were derived from the CP QOL-Child (Parent Proxy version) and normalized to a 0–100 scale in accordance with the scoring protocol. Tables 2 and 3 present the descriptive statistics (mean ± standard deviation) of the domain scores stratified by age and gender, respectively.

Children in the 9–12 years age group generally reported higher QoL across most domains compared to those in the 4–8 years group. Notably, the greatest mean score was observed in the domain of **social well-being and acceptance** (71.02 ± 10.80), whereas the lowest mean score in both age groups was found in **participation and physical health** for the 4–8 years group (52.26 ± 16.57). The **family health** domain also showed a marked difference, with a higher score in older children (75.50 ± 11.67) compared to younger ones (68.75 ± 20.39).

Male participants consistently showed higher domain scores than females in most areas except for **access to services** and **family health**, whereas females reported slightly higher means. The domain of **social well-being and acceptance** had the greatest mean score among males (71.57 ± 10.21), while **participation and physical health** were the lowest among females (57.39 ± 13.65). The **family health** domain was notably higher among females (80.47 ± 12.60) compared to males (71.04 ± 11.71), suggesting a potential gender-based carer perception difference.

These findings suggest that while children with CP generally exhibit moderate to high QoL in domains such as social well-being and emotional functioning, deficits remain, particularly in family health and physical participation. Age and gender appear to influence domain-specific QoL, though the small sample size warrants cautious interpretation.

Table 1 Demographics of Participants

Age Group (in Years)	Males (in Numbers)	Females (in Numbers)
4–8	3	0
9–12	6	4

Table 2 CP QOL-Child Domain Scores by Age Group

Domain	4–8 Years (n = 3)	9–12 Years (n = 10)
Social well-being and acceptance	66.32 ± 1.59	71.02 ± 10.80
Feelings about functioning	67.01 ± 7.54	61.42 ± 20.10
Participation and physical health	52.26 ± 16.57	61.20 ± 14.47
Emotional well-being and self-esteem	64.58 ± 4.17	68.33 ± 17.12
Access to services	68.75 ± 12.50	70.00 ± 13.90
Pain and impact of disability	63.02 ± 12.50	64.06 ± 13.90
Family health	68.75 ± 20.39	75.50 ± 11.67

Table 3 CP QOL-Child Domain Scores by Gender

Domain	Male (n = 9)	Female (n = 4)
Social well-being and acceptance	71.57 ± 10.21	66.25 ± 8.05
Feelings about functioning	65.12 ± 16.36	57.29 ± 22.45
Participation and physical health	59.92 ± 15.97	57.39 ± 13.65
Emotional well-being and self-esteem	68.29 ± 15.96	65.63 ± 17.05
Access to services	68.75 ± 15.27	71.88 ± 16.54
Pain and impact of disability	63.54 ± 12.01	64.45 ± 17.05
Family health	71.04 ± 11.71	80.47 ± 12.60

Discussion

This study aimed to assess the QoL in children with CP aged 4–12 years using the CP QOL-Child (Parent Proxy version). The analysis of domain-specific scores revealed that participants generally reported higher QoL in areas of social well-being, emotional functioning, and acceptance, whereas lower scores were observed in domains such as participation

and physical health and family health. These findings are in alignment with previous literature suggesting that although children with CP can experience a positive sense of social integration, their physical challenges and the burden on family carers remain substantial.[1–3]

The domain of social well-being and acceptance showed the highest mean scores across both age groups and genders. The encouraging environment of the special school where participants were recruited may be the reason for this. Social confidence and acceptability may be enhanced by regular educational support, structured peer engagement, and access to therapy. These results are in line with the research done by Dickinson et al & Mcmanus et al that highlights how inclusive environments help these children achieve better social outcomes.[3,9]

On the other hand, particularly in the younger age groups, family health scored the lowest overall. This shows that the burden of providing care has a significant impact on caregivers' mental and physical health. These results are supported by the research conducted by Basaran et al and Okurowska-Zawada et al that reports elevated stress, burnout, and reduced QoL in carers of children with CP.[14,15] The disproportionately low scores in this domain reinforce the importance of including family-centered services and carer support in rehabilitation plans.

Age-wise comparisons indicated slightly higher QoL scores among the older (9–12 years) group across most domains. This may indicate increased parental adaptation to the child's condition over time or a higher degree of autonomy and participation in older children. However, lower scores in physical domains among younger children may also be influenced by the evolving nature of disability-related challenges and developmental expectations. This trend is consistent with the work of Davis et al, who reported that adaptation and coping strategies among families often improve over time.[2]

Gender-wise analysis revealed higher QoL scores among male participants in most domains, though females showed higher scores in family health and access to services. Although gender-based differences are not consistently reported in CP-related QoL studies, some evidence, including from Das et al and Dobhal et al, suggests that cultural factors and parental expectations may influence reported outcomes.[16,17] These findings point to the need for gender-sensitive approaches in clinical and rehabilitation planning.

Despite the insights gained, the study has its limitations. The small sample size (n = 13) restricts generalizability and reduces the statistical power to ascertain significant group differences. The utilization of the Parent Proxy version of the CP QOL-Child, though valid, may not capture the child's perspective accurately, especially for subjective domains such as emotional well-being. Additionally, the recruitment of all participants from a single school may limit demographic and socioeconomic diversity.

Future research should aim to include wide-ranging, more diversified samples and consider using both parent- and child-reported QoL tools. Longitudinal studies may also offer understanding into how QoL evolves with age, intervention, and carer adaptation. Moreover, qualitative interviews with families could enhance understanding of the contextual factors that shape QoL in CP.

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Assessment of Microbial Contamination on High-Touch Public Surfaces and its Implications for Community Health: A Cross-Sectional Study from Urban South India

Muhammed Suhail S.

Abstract

Objectives High-contact public surfaces, such as bus seatbacks, mall escalator belts, and theater armrests, may act as reservoirs of opportunistic and antimicrobial-resistant microorganisms, posing a significant but underreported risk to community health. In urban environments like Coimbatore, Tamil Nadu, surface-level microbial surveillance remains poorly characterized. This study aimed to assess the magnitude, composition, and density of microbial contaminants on commonly touched surfaces across transit and commercial hubs.

Methods A total of 30 surface swab samples were collected from five public locations, including intra-city TNSTC buses, inter-state SETC coaches, Brookfields Mall escalator handrails, multiplex theaters and local bus seat-grips. Standardized 25 cm^2 areas were swabbed using sterile, saline-moistened swabs and cultured on Nutrient Agar, MacConkey Agar, and Sabouraud Dextrose Agar. Colonies were incubated at 37°C for 24–48 hours. Isolates were identified by Gram staining, colony morphology, and biochemical assays. Antimicrobial susceptibility testing was performed using the Kirby–Bauer disc diffusion method (following Clinical and Laboratory Standards Institute 2021 guidelines.

Results Out of 30 surface samples, 28 (93.3%) were culture-positive, yielding 48 distinct microbial isolates. Gram-negative organisms accounted for 54.2% of isolates, including *Escherichia coli* (16.7%), *Pseudomonas aeruginosa* (14.6%), and *Klebsiella pneumoniae* (12.5%), while Gram-positive bacteria included *Staphylococcus aureus* (20.8%) and coagulase-negative staphylococci (10.4%). Fungal species such as *Aspergillus niger* and *Candida albicans* were also detected. The highest bioburden was observed on fabric seatbacks in SETC coaches (6.7×10^4 CFU/cm^2), exceeding values commonly reported in global literature. Multidrug resistance was noted in *P. aeruginosa* and *S. aureus*, particularly to ceftazidime, gentamicin, and cotrimoxazole.

Conclusion This study highlights the significant microbial load and presence of potential pathogens on high-touch public surfaces in Coimbatore. Findings suggest a plausible risk for fomite-mediated transmission, especially in enclosed environments like buses and theaters. The detection of multidrug-resistant strains supports the urgent need for improved surface sanitation protocols, public awareness on hand hygiene, and routine environmental surveillance programs that include antimicrobial resistance profiling.

Keywords public health, fomite contamination, CFU/cm^2, antimicrobial resistance, surface microbiology, hand hygiene

Introduction

Every day, millions of people in Indian cities touch surfaces that could potentially expose them to pathogens – without even realizing it. From escalator belts to bus handles and theater armrests, high-contact public surfaces are invisible highways for microbial traffic, yet they are rarely prioritized in India's public health strategies. Although oral and respiratory infections are rampant in urban settings, the contribution of environmental fomites to microbial exposure remains poorly quantified and largely ignored in preventive planning.[1]

Although international studies have shown that surfaces in public transit systems carry dense microbial loads – including multidrug-resistant organisms – India lacks baseline data quantifying viable bioburden on shared public surfaces, especially in tier-2 cities like Coimbatore.[2-5] Few Indian studies have attempted to quantify this burden or analyze associations with surface type, hygiene protocols, or ventilation status.[3,4] Existing literature either focuses on hospital settings or uses dry-swab techniques without reporting microbial density in colony-forming units per square centimeter (CFU/cm^2). Studies in high-density urban areas such as Delhi, Mumbai, and Bengaluru suggest microbial diversity on transit surfaces but often lack standardized enumeration techniques.[3]

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This study aims to fill that void. We cultured and phenotyped microbial communities from 30 high-touch surfaces across transit and commercial hubs in Coimbatore and estimated their bioburden using standardized surface area sampling and CFU/cm^2 quantification. By identifying potentially pathogenic and antimicrobial-resistant species on public fomites, this work contributes to the growing conversation around environmental hygiene and community-acquired infections.

We anticipated that our findings would reveal significant surface contamination – especially in enclosed, poorly ventilated settings – and that the recovered species would include microbes of clinical concern such as *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa*. These insights may inform sanitation protocols, guide policymaking on hand hygiene infrastructure, and serve as a springboard for further antimicrobial resistance (AMR) surveillance in community environments.

Objective

This study aimed to

1. quantify and characterize the microbial flora colonizing high-contact public surfaces in urban Coimbatore through culture-based techniques and phenotypic identification and
2. explore the potential for indirect transmission of opportunistic or resistant microbes via these surfaces to humans, as a hypothesis-generating observation, without directly assessing clinical transmission or infection outcomes.

Methods

Study Setting and Design

A descriptive, institution-based cross-sectional investigation was conducted over a 2-week period (March 2025) in Coimbatore, Tamil Nadu, India. Sampling locales encompassed five high-frequency contact matrices: TNSTC intra-city bus-handles, SETC inter-state coach fabric seatbacks, Brookfield Mall escalator handrails (rubberized belts), multiplex theater armrests (polymer composites) and local bus seat-grips. These environments were selected to represent diverse microclimates and material substrata influencing microbial adhesion and biofilm establishment.

Surface Sampling Protocol

Standardized surface bioburden was assessed using a 25 cm^2 stainless-steel template. Sterile, saline-moistened rayon swabs were rolled across each demarcated area under constant pressure (~0.5 kg/cm^2) for 30 seconds to maximize recovery of sessile organisms.[6] Following collection, swabs were immediately immersed in 5 mL Amies transport medium, sealed, and maintained at 4°C in an insulated vaccine carrier, with transit to the microbiology laboratory completed within 90 minutes.

Culture and Enumeration

Upon arrival, swabs were vortexed for 30 seconds, and 100 µL aliquots were inoculated onto:

- Tryptic Soy Agar for total aerobic heterotrophs
- MacConkey Agar for Gram-negative enterobacteria
- Sabouraud Dextrose Agar for yeasts and filamentous fungi

Plates were incubated at 37°C under aerobic conditions for 24–48 hours. After incubation, colony-forming units were counted manually using a stereomicroscope, and microbial load was calculated as CFU/cm^2. Colony morphology was catalogued (size, pigment, hemolysis pattern) to guide selection for further characterization.

Phenotypic and Automated Identification

Representative colonies were subcultured for Gram staining and biochemical profiling, including catalase, coagulase, oxidase, urease, motility, triple sugar iron agar, indole, citrate utilization, and mannitol fermentation assays. For confirmatory species-level taxonomy, isolates were submitted to the VITEK® 2 Compact automated system, utilizing Gram Negative and Gram Positive cards per manufacturer's protocols. In cases where colony morphology and biochemical traits yielded ambiguous results, species-level confirmation was performed using PCR-based gene amplification targeting conserved genes.[7]

Antimicrobial Susceptibility Testing

Antimicrobial Susceptibility Testing (AST) was performed using the Kirby–Bauer disk diffusion method[8] on Mueller–Hinton Agar, supplemented with 5% sheep blood for streptococci, following Clinical and Laboratory Standards Institute (CLSI) 2021 guidelines.[9] This procedural method was selected for its reproducibility in assessing zone inhibition across multiple antibiotic classes. Inocula were standardized to 0.5 McFarland turbidity.[9] Disks tested included amikacin (30 µg), ciprofloxacin (5 µg), ceftazidime (30 µg), cefepime (30 µg), gentamicin (10 µg), imipenem (10 µg), meropenem (30 µg), tetracycline (30 µg), and cefoxitin (30 µg). *S. aureus* isolates exhibiting inhibition zones ≤21 mm around cefoxitin were designated methicillin-resistant *S. aureus* (MRSA).[9]

Zone diameters were measured with digital calipers; interpretations adhered strictly to CLSI M100 performance breakpoints.[9]

Quality Assurance

Media sterility was validated by incubating 5% of each batch uninoculated at 37°C for 24 hours. Performance checks employed American Type Culture Collection (ATCC) control strains *S. aureus* ATCC 25923 and *E. coli* ATCC 25922. All procedures conformed to institutional standard operating procedures, with dual-operator verification of critical steps and periodic log audits.

Data Management and Statistical Analysis

Data were logged in Microsoft Excel and analyzed using SPSS software, version 25. Descriptive statistics (mean ± SD, range) were computed for CFU/cm^2 by surface category. Comparative analyses such as open-air versus enclosed environments were performed using independent-samples *t*-tests, with statistical significance set at two-tailed $p < 0.05$.

Ethics

Institutional Ethics Committee exemption was obtained (Ref. PA-AHS-EC/2025/03) as no human participants were involved.

Results

Microbial growth was recovered from 28 of the 30 surface samples (93%). The mean surface bioburden across all locations ranged from 2.8×10^3 to 6.7×10^4 CFU/cm^2. Notably, enclosed, climate-controlled environments such as SETC coach interiors and multiplex theaters exhibited significantly higher colony counts compared to open-air TNSTC buses ($p < .05$). For example, SETC coach fabric seatbacks averaged $6.70 \times 10^4 \pm 1.0 \times 10^4$ CFU/cm^2 (range, $5.0 \times 10^4 – 8.5 \times 10^4$), whereas plastic hand grips in TNSTC buses averaged only $2.80 \times 10^3 \pm 5.0 \times 10^2$ CFU/cm^2 (range, $1.8 \times 10^3 – 3.9 \times 10^3$) (Figure 1, Table 1).

The high load on SETC coach seatbacks is likely due to the porous nature of the fabric, inadequate cleaning frequency, and the lack of sunlight or ventilation in enclosed coach compartments. These environmental factors may have favored the persistence and multiplication of surface-bound microbes.

Predominant bacterial isolates identified included *S. aureus* (β-hemolytic, coagulase-positive), *E. coli*, *Klebsiella pneumoniae*, and *P. aeruginosa* (pyocyanin-producing, oxidase-positive), as well as *Staphylococcus epidermidis* and *Bacillus* spp. Among fungal organisms, *Aspergillus niger* (with characteristic conidial heads) and *Candida albicans* (germ tube–positive) were detected.

Environmental impact analysis revealed that closed, air-conditioned settings promoted greater microbial load compared to well-ventilated or open spaces ($p < .05$), likely due to humidity retention and reduced exposure to **ultraviolet** light. Surface material also influenced microbial diversity: porous substrates such as fabric and rubber escalator belts supported polymicrobial biofilms, whereas smooth plastic

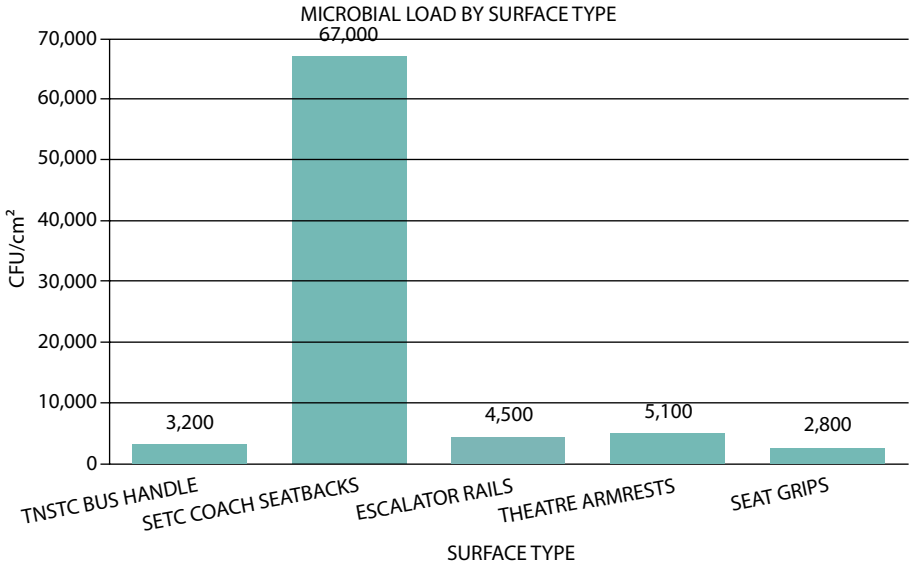

Figure 1 A bar chart showing mean CFU/cm^2 recovered from five high-touch public surfaces in Coimbatore. SETC coach fabric seatbacks exhibited the highest bioburden (~6.7×10^4 CFU/cm^2), whereas plastic seat grips had the lowest bioburden (~2.8×10^3 CFU/cm^2)

Table 1 Microbial Contamination by Surface Type

Surface Sampled	Mean CFU/cm^2 (mean ± SD)	Range (CFU/cm$^{2)2)}$)	Main Isolates	Phenotypic Traits
TNSTC Bus Handles	3.20×10^3 ($\pm 6.0 \times 10^2$)	$2.0 \times 10^3 – 4.4 \times 10^3$	*S. aureus*, *S. epidermidis*	β-Hemolysis on blood agar; catalase-positive cocci
SETC Coach Seatbacks (fabric)	6.70×10^4 ($\pm 1.0 \times 10^4$)	$5.0 \times 10^4 – 8.5 \times 10^4$	*P. aeruginosa*, *Bacillus cereus*	Pyocyanin pigment; endospore formation
Brookfield	4.50×10^3	$3.5 \times 10^3 – 5.5 \times 10^3$	*E. coli*, *K. pneumoniae*	Lactose
Escalator Rails	($\pm 7.0 \times 10^2$)		*C. albicans*	fermentation; germ tube positive
Multiplex Theater Armrests	5.10×10^3 ($\pm 8.0 \times 10^2$)	$4.0 \times 10^3 – 6.2 \times 10^3$	*A. niger*, *S. aureus*, *C. albicans*	Conidial heads; coagulase-positive; budding yeasts
Bus Seat Back Grips (plastic)	2.80×10^3 ($\pm 5.0 \times 10^2$)	$1.8 \times 10^3 – 3.9 \times 10^3$	*Micrococcus luteus*, *Bacillus* spp.	Yellow pigmentation; endospore formers

Note: Values are mean colony counts (CFU/cm^2) (± SD, range) from n = ~6 samples per category. The predominant isolates from each surface are listed.

and stainless-steel surfaces typically harbored monomicrobial growth.

Preliminary AST using VITEK® 2 flagged resistance in clinically relevant strains. Approximately 20% of *S. aureus* isolates were identified as MRSA, and 15% of *P. aeruginosa* isolates demonstrated elevated ceftazidime minimum inhibitory concentrations (MICs). These findings suggest the potential for environmental reservoirs of multidrug-resistant organisms in community settings.

Phenotypically, common isolates included *S. aureus* (β-hemolytic, coagulase-positive), *S. epidermidis*, Gram-negative enteric bacteria (*E. coli*, *K. pneumoniae*), and *P. aeruginosa* (pyocyanin producing, oxidase-positive), as well as environmental spores (*Bacillus* spp.) and fungi (*A. niger*, *C. albicans*). Importantly, antibiotic susceptibility profiles indicated that ~20% of *S. aureus* were MRSA and ~15% of *P. aeruginosa* showed elevated ceftazidime MICs, highlighting the presence of resistant strains on community surfaces.

Discussion

This survey confirms that routinely touched public surfaces in Coimbatore frequently carry substantial microbial burdens. The highest loads on fabric upholstery (e.g. seatbacks) likely reflect their porosity, poor cleaning compliance, and limited exposure to UV and airflow. By contrast, smooth plastic or metal surfaces with higher touch frequency had lower counts – possibly due to more frequent disturbance or cleaning.

These findings align with earlier urban transit studies that reported CFU levels ranging from 10^3 to 10^4 on vehicle interiors. For example, a study conducted in Canada found that untreated railings and handles on buses and trains routinely exceeded 10^4 CFU/cm^2.[3,10,11] The presence of potentially pathogenic and multidrug-resistant organisms raises theoretical concerns. Contaminated surfaces may act as fomites via hand-to-mouth or hand-to-nose contact and could introduce microbes into the oral or respiratory tract. However, we did not assess actual transmission or infection outcomes in this study. Thus, Objective 2 is hypothesis-generating only; no clinical associations were tested.

The unusually high mean bioburden observed on SETC coach seatbacks (~67,000 CFU/cm^2) exceeds values commonly reported in global literature.[4,5] This could be attributed to a combination of factors, including:

- lack of routine deep cleaning.
- highly porous cloth upholstery that promotes moisture retention; and
- poor ventilation in enclosed coaches allowing microbial persistence.

Other Indian studies have similarly identified elevated microbial counts in dense commuter environments with fabric-based infrastructure, supporting the plausibility of our findings.[3,4]

While AMR in environmental isolates does not directly equate to clinical risk, the identification of MRSA and ceftazidime-non-susceptible *P. aeruginosa* on public surfaces suggests the existence of a silent AMR reservoir. This echoes WHO and CDC concerns about environmental AMR persistence.[11,12]

Limitations

This pilot study has several limitations. First, the small sample size (n = 30) and single-timepoint sampling limit the generalizability of findings. Second, AMR profiling was preliminary

and based on phenotypic data; molecular typing and resistome analysis were not performed. Third, environmental differences in material composition and cleaning frequency may confound direct surface comparisons.

No clinical or epidemiological link was established between contaminated surfaces and infection in humans, and our results should be interpreted as indicative of exposure potential, not disease burden.

Recommendations and Future Directions

1. Surface disinfection protocols should be standardized across transit systems, malls, and theaters using EPA-approved agents with proven efficacy against biofilms.
2. Hand sanitizer dispensers should be installed at strategic points such as boarding gates, entryways, and elevator terminals.
3. Future surveillance should be expanded with genomic tools like 16S rRNA sequencing and AMR gene panels to better understand the resistome and microbial ecology.
4. Public awareness campaigns focused on fomite hygiene, AMR risk, and proper handwashing practices should be developed and disseminated.

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Ethics Approval and Consent to Participate

This study did not require ethical approval as it involved no human participants.

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Consent for Organ Donation in India: Factors, Challenges, and Opportunities – A Review

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Abstract

India's organ donation rate remains under 1 per million population, markedly lower than the consent rates observed in Canada and Spain. This narrative review synthesizes evidence from Indian and global literature to explore systemic, sociocultural, and individual factors influencing consent for deceased organ donation in India. Systemic barriers include delayed referrals, inadequate hospital infrastructure, and a shortage of trained transplant coordinators. Sociocultural factors, such as family decision-making under the Transplantation of Human Organs Act (1994), religious misconceptions, and concerns about bodily integrity, significantly hinder consent. Individual factors, including low awareness and a knowledge–action gap despite altruistic intentions, impede progress. Comparative analysis with Canada and Spain highlights the efficacy of structured referral systems and presumed consent models. We recommend mandatory physician training and the adoption of uniform hospital protocols. In addition, culturally sensitive awareness campaigns led by religious leaders and establishment of a national donor registry are essential. Bridging India's organ donation gap requires addressing these barriers at multiple levels. Coordinated medical, cultural, and policy reforms will be essential.

Keywords organ donation, consent rates, deceased donation, systemic barriers, sociocultural factors, religious misconceptions, awareness on organ donation, Transplantation of Human Organ Act, India, global comparison

Introduction

Organ donation is a cornerstone of contemporary medical care, providing a vital lifeline for individuals facing end-stage organ failure and significantly enhancing global health outcomes. Despite notable advancements in medical science, a considerable imbalance stays between the number of organs needed and the number of those donated. For example, a retrospective population-based analysis from Canada reported a 60% consent rate for deceased organ donation, reflecting a well-structured system.[1,2] In contrast, India continues to experience difficulties, with a deceased organ donation rate of <1 per million people (pmp), far below from global leaders like Spain at 52.6 pmp in 2024 according to Spanish National Transplant Organization. According to WHO, only around 0.01% of people in India donate their organs after death, highlighting low participation rates.[3,4]

This stark disparity reflects a complex interplay of systematic insufficiencies, sociocultural barriers, and individual beliefs that hinder consent in the Indian context. India's organ donation framework, regulated by the Transplantation of Human Organs Act (THOA 1994), faces challenges such as inadequate referral mechanisms, limited public awareness, and infrastructural constraints,[5,6] religious misconceptions, the pivotal role of family decision-making,[7–9] and low awareness in marginalized communities, with attitudes shaped by education, also influencing consent outcomes.[8,10,11] Conversely, countries with well-structured donation programs, such as Canada and Spain, highlight the value of prompt referrals by clinicians and well-coordinated consent procedures.[1,2]

In India, decisions surrounding organ donation are often shaped by individual demographics, communication with healthcare providers, and widespread misconceptions. Although many individuals express support for organ donation, this does not consistently result in actual consent, largely due to mistrust and a lack of accurate, accessible information.[6,12] Additionally, findings from a retrospective Indian study identified limited physician engagement and delayed discussions as key contributors to missed donation opportunities.[4,13] Misinformation and cultural beliefs, particularly in marginalized communities like rural areas and urban slums, further discourage participation,[8] where decisions are often made collectively and guided by family or community leaders.[9,14]

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To better understand the decision-making process surrounding organ donation, it is imperative to examine both facilitators and barriers. Research conducted in tertiary hospitals across North and South India shows that consent from a deceased person's family is influenced by factors such as emotional readiness, counseling effectiveness, and existing awareness.[10,11,15] Moreover, noticeable regional variations in attitudes toward organ donation – across southern, eastern, central, and northern regions – underscore the need for localized, culturally attuned approaches.[9,16]

A focus group study involving college students in South India illustrated a growing openness toward organ donation among younger populations, particularly when awareness efforts were aligned with cultural values.[9,14] Nonetheless, significant barriers persist, especially in translating potential donors into actual donors – a process still hindered by systemic inefficiencies and trust deficits.[5,6] Even in autopsy settings, where organ donation discussions could be introduced, securing family consent remains a key challenge.[10,15]

This narrative review synthesizes evidence from Indian and global literature to explore the systemic, sociocultural, and individual factors influencing consent for deceased organ donation. Although the focus remains on deceased donation, insights from living and corneal donation are considered where relevant.[9,17,18] The objective is to identify barriers and facilitators within the Indian context and provide a foundation for culturally sensitive, evidence-informed strategies to strengthen the country's organ donation system.

Review Approach

Literature Selection

A structured narrative review approach was undertaken to synthesize factors influencing consent for deceased organ donation, with particular attention to the Indian context and other culturally conservative settings. This approach was chosen to allow flexibility in capturing diverse study designs while supporting a systematic process of selection and synthesis.

Search Strategy

The literature search was conducted across PubMed, Google Scholar, Scopus, and leading Indian medical journals, covering publications from December 2013 to May 2025.

Search terms combined keywords related to "deceased organ donation," "consent," "attitudes," "awareness," and "India," along with comparable sociocultural regions (eg, Middle Eastern countries). Inclusion criteria encompassed peer-reviewed quantitative, qualitative, or mixed-methods studies addressing factors influencing consent in deceased donation. Studies limited to surgical outcomes, transplantation techniques, or unrelated clinical aspects were excluded, as were non-peer-reviewed reports, conference abstracts, and inaccessible full texts. This structured process ensured that the review remained comprehensive yet focused on consent-related determinants across relevant populations.

A total of thirty-one peer-reviewed studies, published between the time frames, were included in this review. These studies employed diverse methodologies, including cross-sectional surveys, observational designs, focus group discussions, and systematic reviews. Populations studied encompassed patient attendants, family members of the deceased, healthcare professionals, and members of the public across multiple regions of India, ensuring both thematic breadth and contextual depth.

Literature Synthesis

A thematic synthesis was conducted to categorize the findings into three primary themes:

- Systemic factors: This theme encompasses hospital infrastructure, referral processes, and availability of trained counselors. Systemic barriers often hinder the effective facilitation of organ donation, highlighting the need for improved institutional frameworks and support systems within healthcare settings.
- Sociocultural factors: The influence of family, religious and cultural beliefs, and community norms play a pivotal role in shaping attitudes toward organ donation. Understanding these sociocultural dynamics is essential, as they can either encourage or deter individuals from consenting to organ donation.
- Individual factors: Individual characteristics such as awareness, education, urban versus rural residency, and personal attitudes significantly affect the willingness to donate. This theme underscores the varied levels of understanding about organ donation among different demographics and how this knowledge influences decision-making.

A comparative analysis was performed between Indian studies against global data, allowing for a broader context. This comparison not only highlights unique challenges faced in India but also identifies best practices that may be adapted from other countries to improve consent rates for organ donation.

Systemic Factors Influencing Consent

Timely Referrals

The timeliness of referrals for potential organ donors is a critical systemic factor influencing consent rates. In Canada, a

study by Singh et al found that late referrals accounted for 45.2% of missed donation opportunities, highlighting the direct impact of delayed identification and referral of potential donors on overall organ donation rates.[1,2] The study analyzed 34,837 referrals and concluded that optimizing the referral process is essential to increasing consent and donation rates.[1]

In India, the situation is compounded by the absence of standardized protocols for identifying brain-dead patients across many hospitals. These gaps in procedure, along with infrastructural limitations, significantly reduce the number of potential donors and contribute to delays in the referral process. A study by Jha et al highlighted that delays in brain death identification directly impacted referral efficiency, with the lack of clear guidelines further exacerbating this challenge.[13] Table 1 compares the organ donation referral practices between Canada and India, highlighting systemic differences like referral timeliness and infrastructure. Similar systemic bottlenecks have been observed by Sen et al in a single-centre study conducted in a South Indian tertiary care hospital, where inadequate infrastructure and insufficiently streamlined workflows resulted in missed donation opportunities.[5]

Physician and Coordinator Involvement

Physician and transplant coordinator involvement is another major systemic determinant of consent for organ donation. The CMAJ (2021) study found that physician participation, alongside trained coordinators, in the consent process significantly increased consent rates[1] as families were more likely to agree to donation, emphasizing the importance of a multidisciplinary approach.[1,2]

In India, the scenario is characterized by a severe shortage of trained transplant coordinators, which poses a major barrier.[5] This shortage is exacerbated by physicians' reluctance to engage in organ donation discussions, often due to cultural sensitivities and a lack of training in end-of-life conversations, a finding supported by studies across South and North India.[4,7,15] Studies have shown that many Indian physicians are hesitant to initiate discussions about organ donation, fearing negative reactions from families or concerns about religious and cultural beliefs.[5,9,19] This reluctance, coupled with inadequate end-of-life communication skills, reduces the likelihood of consent (Figure 1).[12]

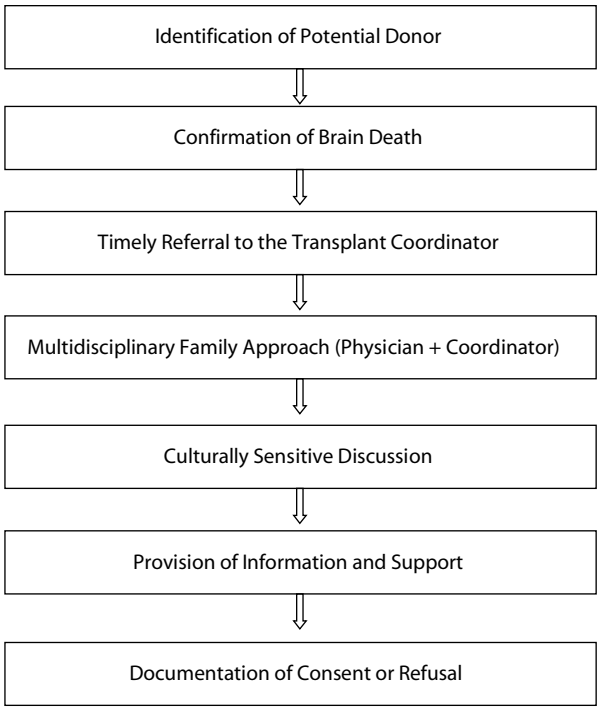

Figure 1 Flowchart of the ideal organ donation consent process involving physicians and coordinators

Consent Approach

The approach used to seek consent from families is a crucial factor influencing the outcome. The study by Singh et al reported that in-person approaches were significantly more effective than those conducted by phone.[1,2] In-person requests, especially those involving both a physician and a trained coordinator, resulted in higher consent rates, as families were able to ask questions, receive emotional support, and better understand the process.[1] India's cultural preference for face-to-face communication, particularly in sensitive matters such as organ donation, aligns with this, yet the lack of trained personnel limits its implementation.[6,11] Family discussions, often collective and deliberative, mediate consent intentions, with effective communication reducing refusals.[9,15,20] Misconceptions among patient attendants and families further complicate this process, necessitating structured, culturally attuned approaches.[8,10]

Table 1 Comparison of organ donation referral practices between Canada and India, highlighting systemic differences

Parameter	Canada	India
Referral Guidelines	Mandatory, standardized[1]	Largely absent[13]
Brain Death Certification Facility	90% hospitals are equipped[1]	10% hospitals are equipped[4]
Referral Timeliness	55% timely[1]	<20% timely[13]
Consent Rate (Impact on Donation)	60% consent rate[1]	30–35% consent rate (hospital studies)[13]

Sociocultural Factors Influencing Consent

Family Influence

Because of India's collectivist cultural context, families are deeply involved in making significant decisions, especially those related to death and postmortem practices. The THOA (1994) mandates that in the absence of a registered donor card or written consent from the deceased, approval from the next of kin is legally required. This places considerable emotional pressure on families, who are often expected to decide amid grief, confusion, and time constraints.

A systematic review highlighted that refusal from family members remains a primary barrier to organ donation in India, with approximately one-third of families declining consent – even in cases where the deceased had previously shown support for donation.[10,18] Such refusals are frequently rooted in emotional turmoil, uncertainty regarding the individual's final wishes, or fear of making the wrong decision on their behalf.[20]

Additionally, within traditional family hierarchies, younger individuals often yield decision-making authority to elder relatives. A qualitative study among college students in South India revealed that although many students supported organ donation, they acknowledged that the final approval would rest with their parents or older family members.[9,14] These dynamics reflect a broader tendency for familial consensus to override personal autonomy in health-related choices as shown in Table 2.

Even when families are aware of the benefits of donation, external factors such as inadequate counseling, unresolved emotional distress, or apprehension about community judgment can lead to refusal. Findings from a tertiary care center in Northern India confirm that informed families still declined donation because of insufficient support during the decision-making process.[4,20]

These insights emphasize the critical role of structured, empathetic communication and grief counseling in facilitating family consent for organ donation.

Religious and Cultural Beliefs

Religious identity and cultural tradition strongly influence organ donation decisions across India. Although most major faiths in India advocate for donation as an act of compassion and altruism, misinformation and interpretive misconceptions persist. A study reported that around 33% of respondents mistakenly believed that their religion opposes organ donation.[19] Such misunderstandings are more common in rural or conservative communities, where guidance is often drawn from informal sources rather than official religious doctrine.[9]

In focus group discussions among college students in South India, many expressed uncertainties about their religion's stance on organ donation. Some participants stated that even if they personally supported donation, they might refrain from it to avoid disapproval from religious or family elders.[14] This indicates a strong influence of social conformity and a lack of clear messaging from religious authorities.

Similar patterns are observed in other culturally conservative regions. For example, research in Syria found that despite Islam's conditional approval of organ donation, many individuals were discouraged by misinterpretations of religious rulings.[18] This suggests that misconceptions about religious teachings – rather than the teachings themselves – present a global challenge to organ donation acceptance.[2]

Efforts to correct these beliefs have included community outreach and education on religious perspectives. However, Indian studies suggest that such programs are still infrequent and localized, and they lack the consistent visibility needed to challenge entrenched myths effectively.[6,19]

Bodily Integrity and Medical Distrust

A culturally rooted barrier in India involves the belief that the deceased's body should remain whole, out of reverence and to meet spiritual or ceremonial expectations. Many families worry that organ retrieval may cause disfigurement, interfering with traditional funeral practices.[6,18]

Table 2 Common barriers to family consent for organ donation in India

Barrier	Description
Absence of prior consent	Families often reject donation because of uncertainty about the deceased's wishes.[10,20]
Delayed decision due to group dynamics	Decision-making is deferred to elder members, causing indecision or refusal.[9,14]
Authority of elder relatives	Family hierarchies result in elders' opinions overriding younger members.[9,14]
Grief and lack of timely counseling	Emotional shock combined with minimal support leads to avoidance or refusal.[4,20]
Beliefs about bodily integrity	Fears about disfigurement and ritual disruption influence rejection.[6,18]
Religious misconceptions	Misunderstood religious teachings hinder acceptance of organ donation.[9,19]
Medical system distrust	Concerns include premature death declaration and unethical organ use.[6,7]

This belief is often compounded by skepticism toward the healthcare system. Concerns about premature death declarations, improper handling of organs, or illegal trading are common. According to a national review, people were generally more comfortable with eye donation, perceiving it as less invasive and more acceptable than organ donation, which they feared might visibly alter the body.[9,14]

Inadequate knowledge of the medical and legal aspects of donation further fuels anxiety. Several studies noted that people were unsure if hospitals would prioritize saving the patient's life once organ donation was under discussion, or whether the body would be returned with dignity.[7,10,18]

This mistrust stems in part from inconsistent patient experiences, vague communication around brain death, and opacity in how organs are allocated. Families who had previously declined donation frequently cited poor explanations and lack of compassion from medical staff as influential in their decisions.[4,7]

To address these concerns, it is essential to provide families with culturally appropriate, transparent, and respectful explanations about organ donation processes, safeguards against malpractice, and the ethical framework established by the THOA (1994). Building public confidence will require sustained education, community engagement, and institutional accountability across the healthcare system.

Individual Factors Influencing Consent

Awareness and Knowledge

Awareness of organ donation laws and procedures is a significant determinant in the willingness to consent to donation. However, studies consistently reveal limited public knowledge on this topic. A cross-sectional study conducted in North-East India among undergraduate and postgraduate students revealed that only 29.3% were aware of the THOA, underscoring the limited penetration of legal knowledge even in educated populations.[3,9] Further evidence comes from a study in a tertiary care hospital in North India, where 51.67% of respondents identified lack of awareness as the primary reason for hesitancy toward cadaveric organ donation.[4,20] Similarly, a 2024 study assessing residents of urban slums in Chennai identified that general awareness about organ donation remained low despite urban proximity and exposure to health infrastructure.[8,9] This trend of insufficient knowledge appears consistent across various Indian demographic segments.

Attitudes and Altruism

Positive attitudes toward organ donation are present among many Indians; however, this often does not translate into active donor registration or family consent at the time of death.

In a 2023 empirical study, 62.8% of participants reported willingness to donate their organs, yet few had taken steps such as registering or discussing their intent with family.[9,12] A 2023 report examining broader Indian populations also found that although 55.6% held favorable views toward donation, less than 15% were formally registered as donors.[7,9]

Altruism, or the desire to help others, is a strong motivator. International findings from a Canadian study indicate that altruistic intention significantly increases family consent likelihood.[1,2] Indian data echo this: a 2022 cross-sectional study found that individuals with higher levels of empathy were more inclined to support organ donation, showing that internal motivators such as compassion and societal responsibility play key roles.[9,21]

Yet, despite positive individual attitudes, barriers like mistrust, fear, or misinformation often inhibit the actualization of this intent into action.

Education and Socioeconomic Status

An individual's desire to give their organs is significantly influenced by their education background. According to a 2013 study that appeared in the *Indian Journal of Palliative Care*, people who have more education are more receptive to conversations about organ donation.[3,10]

Educated respondents not only demonstrated better understanding of donation processes but were also more willing to advocate within their families. Healthcare workers and medical students – who typically receive structured biomedical education – exhibited much higher levels of awareness and willingness. A 2024 study of South Indian medical students revealed that over 80% had knowledge of organ donation processes and expressed a positive inclination toward registering as donors.[9,22]

On the other hand, a major urban–rural divide remains. A 2025 study at a North Indian tertiary care autopsy center reported that individuals from rural areas showed significantly lower levels of awareness and consent readiness, often due to limited exposure to health education and misconceptions surrounding organ retrieval.[9,15] In another 2024 Chennai-based study, respondents from socioeconomically disadvantaged urban slums also displayed low awareness and uncertainty, despite residing close to hospitals.[8,9] These findings reinforce the importance of context-specific interventions: although general education is a strong enabler, dedicated and culturally relevant outreach is essential in rural and economically disadvantaged communities.

Comparative Analysis: India Versus Global Context

Consent Systems

India follows an opt-in system under the THOA, 1994, which mandates that consent for organ donation must be explicitly

given by the individual before death or authorized by the next of kin afterward. This legal structure results in significant pressure on bereaved families, often leading to refusals. A study in North India found that although awareness was present in some families, the final decision to donate was frequently influenced by emotional stress and a lack of procedural clarity.[4,15]

Similarly, Canada operates under an opt-in model, but it has integrated several systemic reforms to enhance donation rates. The implementation of mandatory referral policies and the creation of national donor registries have contributed to improved outcomes. However, delayed identification of potential donors and inconsistent training among healthcare professionals still hinder progress. A retrospective study from Canada revealed that a significant number of potential donors were missed because of late referrals and suboptimal communication practices.[1,2]

By contrast, Spain employs a presumed consent (opt-out) model as shown in Table 3, where all citizens are considered potential donors unless they explicitly opt out. This system is backed by strong institutional support, public trust, and trained transplant coordinators embedded in hospitals, which collectively result in Spain having among the highest organ donation rates globally. According to a global review, presumed consent systems consistently yield better donation outcomes than opt-in systems, largely due to systemic efficiency and societal normalization of donation.[3,6]

This comparison highlights that the legal framework alone is not sufficient; systemic efficiency and social alignment play crucial roles. Although presumed consent in India would raise ethical and cultural concerns, studies suggest that even within the existing opt-in model, improving referral systems and public awareness could significantly enhance outcomes. For example, data show that public willingness increases when misconceptions are addressed and families are supported during decision-making.[9,12]

Systemic and Cultural Barriers

In Canada, despite progressive legal and policy frameworks, systemic inefficiencies remain a key barrier. A national-level study found that many potential donors were never referred because of unclear hospital workflows or a lack of urgency.

Table 3 Comparison of consent systems and organ donation outcomes across India, Canada, and Spain, highlighting systemic and legal influences

Country	Consent System	Donation Outcome
India	Opt-in (THOA 1994)	Low consent rates; family-dependent decisions[4,13,15,18]
Canada	Opt-in with registry + reforms	Moderate improvement; hindered by delays[1,2]
Spain	Presumed consent (opt-out)	High rates due to systemic and societal support[3,6]

Additionally, transplant coordinators often lack formal training in cultural competence or bereavement counseling, making it difficult to gain consent from grieving families.[1,2]

India experiences similar systemic issues, but deeply rooted cultural and religious beliefs further compound these. A study from a tertiary care center reported that many hospitals lacked transplant coordinators or clear brain death protocols. Consequently, delays in identifying eligible donors and initiating family conversations led to lost opportunities for donation.[4,5] Another study highlighted that healthcare workers themselves were uncertain about when and how to refer potential donors, pointing to a need for nationwide standardization and training.[6,11]

Family dynamics in India exert a significant influence. Decision-making often lies with the head of the family or a collective group, and families may refuse donation because of religious myths, fear of body disfigurement, or mistrust in the healthcare system. A focus group study involving South Indian students revealed that although general awareness about organ donation was high, religious interpretations and family influence strongly shaped their attitudes.[9,14]

A systematic review of Indians living globally corroborated these findings, reporting that 33% believed their religion opposed organ donation and 40% were unsure of their faith's stance. Most major religions support the practice, but this disconnect contributes to a high rate of refusal.[10,18]

By contrast, Spain combines presumed consent laws with intensive systemic support, including on-call transplant coordinators in intensive care units, government-funded awareness campaigns, and protocols that ensure early and empathetic engagement with the family. This cohesive framework greatly increases consent rates and public confidence.[3,6]

India's challenge lies in tackling both systemic and sociocultural obstacles simultaneously. Studies show that early referral, trained personnel, and culturally sensitive counseling significantly improve donation outcomes. For instance, research on consent success found that multidisciplinary discussions involving both physicians and transplant coordinators, along with stepwise documentation, were more likely to result in family approval.[9,13]

Efforts to reform the Indian system must include:

- timely and mandatory referrals;
- hospital-based transplant coordinator training;
- public education focused on debunking religious myths; and
- media campaigns promoting family discussions about organ donation preferences.[5–7,12]

Recommendtations to Improve Consent Rates in India

Organ donation remains a critical problem in India, where the demand for organ transplantation exceeds the available

supply. The country has a low consent rate for organ donation, attributed mainly to culturally rooted misconceptions and a lack of awareness. Addressing these challenges requires specific strategies that improve organ consent rates.

Policy Interventions

To improve organ donation rates in India, one of the first necessary steps is the implementation of comprehensive health policy interventions. The effectiveness of such interventions has been demonstrated by Mahajan et al, who found that improving the knowledge and attitudes of health professionals can significantly promote organ donation.[23] Training programs must emphasize the medical, ethical, and social aspects of organ donation, ensuring that professionals can act as defenders informed about it. By integrating organ donation education into the curricula of medical and nursing schools, we can create a new generation of health professionals equipped to address erroneous perceptions of organ donation between patients and families.[24]

The introduction of structured training in organ donation in hospitals[25] is vital to improve the transplant rates of deceased donor organs. Training should focus not only on clinical aspects but also on communication skills, which allow health workers to interact with empathic families during discussions at the end of life. Educating medical care providers on how to address families about organ donation can lead to higher consent rates, thus addressing the existing knowledge gap identified in several studies.[26,27]

Awareness Campaigns

Specific awareness campaigns are also essential to alter public perceptions and increase consent rates. Culturally rooted misconceptions regarding organ donation often come from a lack of understanding and fear around the medical procedure. Campaigns must be designed to effectively communicate the facts on organ donation and its benefits while addressing common erroneous concepts. For example, many people in India believe that organ donation could desecrate their bodies after death, a lack of discomfort that can be counteracted through community participation and the dissemination of information.[3]

In addition, the incorporation of testimonies from families of donors and transplant recipients in awareness campaigns has the potential to humanize organ donation, which makes it a more identifiable topic for the public.[28] Personal narratives can change perceptions and inspire people to consider becoming donors.

By promoting these awareness campaigns, it is crucial to consider the sociocultural context of India. For example, Jagadeesh et al emphasize the need for effective personalized strategies in rural populations versus urban communities. Campaigns could focus on educating several segments of the population about the concept of brain death, which remains little known in many areas.[27] Integrating organ donation education into school and university curricula, alongside well-structured media campaigns, can normalize the concept and reduce apprehension over time.[3,10,14] By providing culturally sensitive messages that resonate with the values of the community, it is possible to gradually dismantle the deeply erroneous concepts about organ donation.

Systemic Improvements

Another necessary intervention involves exploring opt-out organ donation systems, as noted by Etheredge (2021).[29] While these systems may raise ethical concerns, evidence of other countries demonstrates that opt-out models can significantly increase consent rates for organ donation by presuming consent unless individuals expressly decline. Discussions around this paradigm shift must be guided by comprehensive public discourse to effectively address cultural sensitivities.

In addition, promoting transparent institutional policies and support systems is fundamental. Families often fear that the wishes of their loved ones regarding organ donation will not be respected in the event of death. Establishing clear protocols and hospital guidelines that prioritize organ donation discussions at the end of life is essential to mitigate these concerns.[30] Ensuring that medical care institutions are well equipped and that their staff are trained in organ donation protocols can reassure families about the integrity of the process.

Finally, continuous evaluation and improvement of these strategies are necessary for sustained success. The investigation must be ongoing to evaluate the effectiveness of the policies and campaigns implemented. Understanding trends in public attitudes and knowledge about organ donation can report future strategies. For example, Alex et al illustrate the positive correlation between the greatest awareness and the donation rates of improved organs, highlighting the need for continuing education.[31]

This hierarchical pyramid structures interventions at policy, systemic, community, and individual levels to maximize impact on the organ donation consent.

Policy formulators should establish associations with local leaders and influential community members to facilitate broader engagement.

Community Engagement

Policy formulators should also consider establishing associations with leaders and influential people from the local

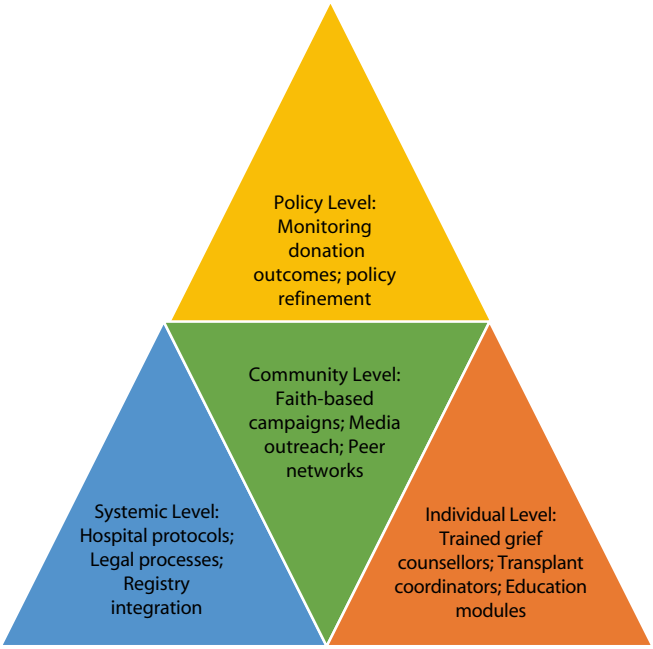

Figure 2 Hierarchical framework for community-based interventions to enhance the organ donation consent process

community to facilitate a greater scope. Involving these key stakeholders can increase credibility and the scope of the campaign, which makes it easier to influence public opinion.[29] Collaboration with local celebrities and respected figures can also help address the stigma associated with organ donation, improving the sense of community participation and collective responsibility for this cause.

A comprehensive community-based framework that includes education, emotional support, and trust-building mechanisms can ultimately serve as the backbone of a successful deceased donation program (Figure 2).

Conclusion

This narrative review underscores the intricate mix of systemic, cultural, and personal factors affecting consent for deceased organ donation in India. Low consent rates stem from late referrals, inadequately trained staff, and the absence of uniform hospital protocols. By contrast, nations like Canada have boosted consent rates to 60% through organized referral systems and skilled coordinators. Cultural influences, such as family dynamics, emotional distress, and respect for elder authority, often result in refusals. Persistent religious misconceptions and concerns about bodily integrity further complicate matters, with many unaware of their religion's position on donation.

At the individual level, limited awareness and education impede donor registration and informed choices, even among medical students and professionals. Although willingness to donate is often expressed, few take steps to formalize or communicate their intent. Overcoming these challenges requires early referrals, culturally tailored communication, and robust public education. Insights from Spain and Canada highlight the importance of coordinated systems and public trust in enhancing outcomes.

Future studies should focus on region-specific research and explore presumed consent models adapted to India's cultural context. Comprehensive reforms across medical, cultural, and policy spheres are critical to increasing consent rates and closing the organ donation gap.

In conclusion, the improvement of organ consent rates in India requires multifaceted strategies that include policies in health training and specific awareness campaigns. By focusing on educating health professionals and dissipating culturally rooted misconceptions through personalized commitment and communication, it is possible to promote a more positive environment for organ donation. The implementation of these strategies can save lives while building a more altruistic community context for organ donation. In the future, collaboration between political leaders, medical care providers, and communities will be fundamental to transform the panorama of organ donation in India.

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Revolutionizing Digital Health in Rwanda: Progress Toward Universal Health Coverage

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Abstract

Rwanda is an African country that is making rapid progress in all sectors, including digital health. This review explores Rwanda's transformative journey in digital health, highlighting key achievements, ongoing challenges, community involvement, and future prospects. Rwanda's commitment is evident in using electronic health records, telemedicine, and mobile health applications. Rwandan institutions, including Rwanda Biomedical Center, Rwanda Ministry of Health, Rwanda Health Information Exchange, Rwanda Development Board, Partners in Health, universities, and several nongovernmental organizations, have made significant contributions to revolutionize digital health in Rwanda. However, the country continues to face barriers, including limited digital infrastructure, financial constraints, and disparities in digital literacy. Despite these challenges, Rwanda's strategic vision, including the integration of artificial intelligence and nationwide digital identity systems, positions it as a potential model for digital healthcare innovation across Africa. This review underscores the critical role of policy, community engagement, and technological investment in achieving equitable and efficient healthcare delivery through digital transformation.

Keywords Digital health; Rwanda; Electronic Health Records; Telemedicine; Healthcare innovation

Introduction

The term digital health is rooted in eHealth Digital as a rapidly developing field with the convergence of innovation and medical services, and holds a huge commitment to changing medical care frameworks around the world.[1] eHealth is the convenient and secure use of data and communication technologies in health and health-related fields, including medical care management, health observation, health and wellness education, information, and inspection.[2] Digital health includes the use of innovations such as electronic health records (EHR), mobile health (mHealth) applications,

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electronic medical records (EMR), wearable devices, telemedicine, and personalized medicine, all aiming to advance medical care, improve access, monitor health and quality, and enhance patient outcomes.

Rwanda leverages information communication technologies (ICT) to enhance the provision and availability of healthcare services through digital health. The Health Sector Strategic Plan (HSSP IV) is in line with the Rwanda National Strategy for Transformation 2018–2024,[3] which aims to promote universal health coverage (UHC) by utilizing telemedicine technologies to expand access to healthcare services with a focus on ensuring accessible, affordable, high-quality, and efficient healthcare delivery. Rwanda is advancing digital health by focusing on personalized healthcare and providing high-quality and easily accessible healthcare services through telemedicine.[4] The country's healthcare sector has undergone modernization through various measures. One notable intervention is the adoption of electronic health record (EHR) systems, including electronic medical records (EMRs), in hospitals, clinics, and health centers. This implementation aims to improve patient care by ensuring the secure maintenance of information, correcting errors in data, and preventing data duplication. This implementation aims to improve patient care by ensuring the secure maintenance of information, correcting errors in data, and preventing data duplication. In this study, we explore Rwanda's digital health landscape, including the benefits of advancing digital health, existing challenges and barriers, community engagement, and prospects.

Digital Health in Rwanda

Healthcare systems are among the most relevant elements for improving the well-being of individuals and societies. Healthcare systems consist of facilities, policies, and resources that work together to provide first-class care.[6] These systems are designed to meet the health needs of the population and are influenced by various factors, including technologies. The digital health environment of Rwanda is evolving toward patient-centered care with the increasing adoption of UHC,[7] and the government of Rwanda is collaborating with various initiatives and programs to achieve this goal. The government has implemented EMRs and EHRs throughout its healthcare facilities programs that were introduced long ago and are still running, including Open Medical Records that tracks patient-level data (OpenMRS), Health Management Information System, CAMERWA (a drug medical supply management system managed by the National Pharmaceutical Company), e-learning for nurses, and telehealth services (such as telemedicine ICT used to deliver healthcare services and healthcare information and education to geographically dispersed populations). mHealth applications have also been developed.[5,6] These Health Information Exchange (HIE) systems have been enacted to ensure patient safety and secure sharing of patient information between different healthcare sectors.[8]

Mobile Health

mHealth is defined as the use of mobile technology to support and address health needs.[1,9] The Government of Rwanda, in partnership with private sector organizations such as Babylon Health (which operated as Babyl in Rwanda until December 2023), the largest digital health provider in the country, offered services through mHealth technologies. Patients could receive healthcare from their homes using their mobile phones.[9,10] Patients registered on Babyl's platform via their phones are connected with a nurse who guided them through a triage process enhanced by world-leading artificial intelligence (AI) and symptom checker platforms. Based on the assessment, the patient was scheduled for an appointment with either a senior nurse or a general practitioner, depending on their condition. After the consultation, patients visited the nearest health facility for lab tests, and the lab test results were shared through the platform. Prescriptions were also sent via SMS, allowing patients to buy medicines from pharmacies across the country.[10] This elimination of long hospital queues and the cost-effectiveness of the program led the Rwandan government to enter a 10-year partnership. Through this collaboration, Babylon worked with the Ministry of Health Rwanda to develop a new healthcare delivery model called "Digital-First Integrated Care," which aims to provide people in remote areas access to qualified doctors and nurses conveniently. This initiative will enable all Rwandans to access quality, cost-effective, efficient, and scalable health services, while also reducing waiting times and advancing toward UHC through telemedicine technologies.[7,10]

Rwanda's digital health made a tremendous change when the first Covid-19 case was identified and confirmed in Rwanda on March 14, 2020.[11] Rwanda has since adopted several different projects to combat the pandemic. Among the selected projects is an SMS-based Home-Based Care program, which was introduced in August 2020 to monitor and reduce exacerbations of Covid-19 cases and contacts in home isolation.[9,12] This was a useful implementation in the country's struggle to trace the transmission of the virus in the community, manage the epidemic, and reduce the logistical and financial burden on the health system.[13] "Mbaza" computer system was launched by Rwanda Biomedical Center (RBC) to provide information related to Covid-19 through a short USSD code *114#. This computer system was used to spread the awareness of Covid-19 transmission, preventive measures to be taken, and current updates on restrictions and curfew to all Rwandans who own mobile telephone through their phones.[12,14] By dialing 114, people were able to remotely inquire the way forward in case one would be manifesting

some of the Covid-19 signs and symptoms. Thereby, people would be guided on self-isolation in home, how to take care of patients, daily follow-ups, and the types of first aid needed before further help reaches, and how to prevent transmission while they head to healthcare facilities.[12,14]

EMRs and EHRs

Health information systems (HIS) in Rwanda have significantly contributed to the adoption of digital health in healthcare facilities, promoting patient-centered service delivery. There has been a transition from paper-based to computer-based data storage and processing, along with a growing volume of health data.[15] Facilities in Rwanda use EMRs and EHRs, which are digital versions of patient files. These include medical history, diagnoses, immunization dates, medications, laboratory test results, radiology images, and demographic information essential for making informed healthcare decisions.[16] Healthcare providers from public, private, and nongovernmental organization facilities use these systems to securely share patient information, with the patient's consent, thus ensuring confidentiality in an efficient and consistent way. These systems also reduce paperwork, minimize errors, and prevent duplication by easing the retrieval of records.[16,17] The OpenMRS, a nonprofit, effective, and widely used EMR in Rwanda and other parts of Africa, helps to improve clinical documentation and patient-centered care, especially in primary healthcare.[18] It began with tracking and managing information on patients with tuberculosis (TB) and later expanded to include HIV. OpenMRS allows nonprogramers to report outcomes and key data on HIV/AIDS, malaria, TB, and other diseases. Today, it is also used in global epidemiological research on HIV/AIDS.[18,19] These systems in Rwanda are primarily managed by the RBC, Partners in Health, and the Clinton Health Access Initiative.

Benefits of Advancing Digital Health in Rwanda

In Rwanda, digital health offers significant advantages by improving healthcare accessibility, quality, and efficiency, especially in rural areas where access to healthcare facilities is limited. Digital health solutions also enhance patient engagement by encouraging individuals to take control of their health and help reduce healthcare costs.[12,18] The advancement of digital health represents a revolutionary shift in healthcare delivery worldwide, particularly in providing primary healthcare to achieve UHC. This progress is linked to Sustainable Development Goal (SDG) 9, which focuses on industry, innovation, and infrastructure,[20] and SDG 3, which promotes good health and well-being.[21] Through these goals, Rwanda aims to gain benefits such as improved healthcare accessibility, better health data management, enhanced patient-centered care, improved remote consultations, and other telehealth services, especially in geographically dispersed areas with limited healthcare access.[12,22]

In Rwanda, digital health has strengthened data management systems. EMRs, such as OpenMRS, are widely used across healthcare sectors, improving data privacy, security, and safety.[17,19] When a patient is admitted to any hospital in Rwanda, their information is stored permanently in an EMR system like OpenMRS. This allows healthcare professionals easy access to the patient's medical history, preventing errors such as duplicated or repeated laboratory tests.[23] The patient's medical history is preserved even after discharge, allowing future use if the patient is readmitted.[23]

Furthermore, the citizens of Rwanda benefit from various public and private health initiatives that use telemedicine, mHealth, and online health education to deliver services across the country.[24] These initiatives include Babylon Health, Zipline (a drone delivery program), and Kir'App. Babyl Rwanda collaborates with the National Identification Agency to verify patients' identities, which makes it easier for individuals without phones to access digital healthcare through shared devices by using only their ID numbers.[25] Babyl also works with the Rwanda Social Security Board, which manages community-based health insurance known as Mutuelle de Santé.[26] This affordable insurance supports all citizen groups, especially those with low income, allowing patients to access digital healthcare at the same price as those who visit health facilities, with payment possible via mobile money. Through these collaborations, patients receive cost-effective, scalable, efficient, consistent, timely, and safe healthcare services that minimize harm and risk.[28]

In addition to Babyl, other initiatives promote virtual healthcare through mHealth. For example, Kir'App allows smartphone users to perform self-screening and self-management for diabetes and access online health education.[29] Patients can monitor medical parameters such as blood pressure, blood glucose, body weight, and BMI, and receive advice on diet, hydration, and physical activity when needed. The app also provides extensive information about diabetes and enables users to ask questions to diabetes experts managing the platform.[29] Rwandans benefit not only from quality, affordable, efficient, and scalable healthcare delivery but also from job creation and job training opportunities through the innovative adoption of digital health.[28] For example, since the launch of Babyl Rwanda in 2016, over 300 jobs have been created.[27]

Challenges of Digital Health in Rwanda

Despite Rwanda's progress in promoting primary healthcare and achieving UHC through digital health, the country faces

several barriers similar to other African nations. These challenges include technological, individual, and financial barriers.[7,30] Examples are inadequate telemedicine infrastructure, limited e-health readiness, unreliable internet connectivity, variable service quality, low digital literacy, limited software availability,[31] and concerns about data privacy and security that must be addressed to protect patient information.[32]

Technology Barriers

Some challenges Rwanda faces in adopting telemedicine include inadequate telemedicine infrastructure, such as insufficient equipment and tools, less trained personnel, and unreliable internet connectivity.[33] This infrastructure encompasses telemedicine software platforms, diagnostic imaging systems, HIE systems, mobile clinics, secure messaging platforms, remote monitoring devices, mHealth apps, and EHRs. By January 2023, Rwanda had 4.25 million internet users out of the total population of 13.94 million,[34] revealing a significant gap that needs to be addressed to support telemedicine technologies.[35] The disparity in internet connectivity is more pronounced in rural areas than in urban areas,[36] which also reflects a shortage of trained personnel in rural regions. Additionally, the lack of adequate medical equipment and tools to support e-health remains a challenge that hinders the full advancement of digital health in Rwanda.[30]

Financial Barriers

Although Rwanda is making progress in digital health, financial challenges remain significant. The costs of telemedicine infrastructure and EMRs are high for the institutions using them. This infrastructure includes mHealth apps, telemedicine software platforms, diagnostic imaging systems, and mobile clinics.

Individual Barriers

Inadequate knowledge, low skills, and low labor productivity were challenges the Rwandan government faced during the implementation of Vision 2020. Additionally, some healthcare providers resist digital transformation due to limited telemedicine skills and knowledge.[38] Similarly, patients introduced to telehealth may find it difficult to adapt to the technology, use it effectively, and remember the steps required, especially when using telemedicine self-care equipment.[31]

Community Engagement in the Digital Health of Rwanda

Community engagement is essential for advancing digital health and promoting sustainable healthcare. The government has collaborated with various stakeholders, including healthcare professionals, patients, and community leaders, to ensure continuous quality improvement and safety of care through initiatives such as the Patient Voice Program and Citizen Voice Action.[39] Community engagement plays a vital role in providing feedback on healthcare services, identifying the community's most pressing health needs, and ensuring that digital health solutions effectively address these needs.[39–41] Examples of community engagement in Rwanda include Irembo, a website where citizens can access various government services, including those in the health sector. Through Irembo, people can apply for community-based health insurance (Mutuelle) and provide feedback.[42] Additionally, users can book appointments for tests and apply for vaccination cards for diseases, such as Covid-19 and yellow fever, using Irembo services.

Moreover, some initiatives encourage community engagement in digital health, such as CyberRwanda, a project codesigned by over 800 Rwandan youth along with 200 parents, teachers, healthcare providers, and community leaders.[43] This digital platform targets adolescents aged 12 to 19 and can be accessed via smartphones and tablets in schools for those who do not own phones. It offers storyline narration, a rich digital library, and youth-friendly pharmacy locators. Youth using this platform receive training on family planning and reproductive health to help prevent unplanned pregnancies and HIV. Trained youth also have opportunities to volunteer in various campaigns, sharing their knowledge with their communities.[43]

Future Prospects of Digital Health in Rwanda

The future of digital health in Rwanda holds great promise due to its notable achievements. The plan is to digitalize the entire health system by 2025[3,39] providing every patient with a digital identity.[39] With this system, patients will need to know, keep, and use their digital identity whenever they visit any health facility. This approach will reduce the use of paper records and logbooks that patients currently carry to health centers and increase patients' digital awareness regarding health data standards, data exchange, security, data protection, and the reduction of hardware needs.[39,44]

Despite challenges such as low e-health readiness, limited digital literacy, inadequate infrastructure, and reliance on unsustainable external funding, the insufficient contribution to community-based health insurance remains a concern, especially compared to the high cost of care.[31,45] The government continues to improve patient welfare by raising the standard of living for Rwandans, ensuring access to quality care, and enhancing patient outcomes.[45]

In its pursuit of high-quality well-being, Rwanda is evolving by adopting new and strengthening existing innovative healthcare initiatives. One example is Zipline, which uses drones to deliver blood remotely to health facilities,

particularly in rural areas.[46] This aligns with Rwanda's Vision 2050, which emphasizes the importance of ensuring "universal access to health care."[45]

The introduction of AI will play a vital role in strengthening both existing and new digital health initiatives, contributing significantly to the implementation of Rwanda's Vision 2050.[45] Babyl has made a tremendous impact by using AI in triage and aims to further develop its capabilities to assist medical practitioners in diagnosis and lab test result analysis.[10] This advancement offers hope for providing quality, accessible, affordable, and scalable healthcare services to Rwandan citizens.[4]

Having Zipline, Babyl, and other digital health systems is not enough for Rwanda to achieve a vibrant health sector focused on improving health and reducing causes of illness and death. Dr. Sabin Nsanzimana, former director general of the RBC and current Minister of Health, noted, "Over the years, life expectancy has increased, and maternal mortality has declined while medical technology has advanced." He added, "A good example of high-tech healthcare is the newly inaugurated Rwanda Cancer Centre, which will use targeted radiation to treat different forms of cancer."

Rwanda has made significant developments in health by introducing and sustaining the use of AI and other advanced technologies. These include the establishment of the Rwanda forensic laboratory, the use of unmanned drones to deliver blood to hard-to-reach areas, spraying mosquito habitats to prevent malaria, improving blood services by enhancing safety and providing blood components tailored to patient needs, introducing minimally invasive surgery to reduce cosmetic effects and hospitalization time, and forensic services that enable timely screening for cancers and other serious viruses without transferring samples abroad.

Looking ahead, Rwanda has set goals and strategies to expand the use of these tools and introduce new ones in healthcare, aiming to boost the efficiency and productivity of the health system.

Under Vision 2050, Rwanda aims to achieve UHC through high-tech, data-driven systems that reduce geographic and economic barriers to care. The recently launched HSSP V (2024–2029) outlines key interventions such as the nationwide rollout of e-Ubuzima (EHRs), the Rwanda HIE, and the Health Intelligence Centre, and uses AI and predictive modeling to anticipate disease outbreaks and optimize public health responses. These tools are supported by infrastructure upgrades, including the construction of 10 hospitals and 23 health centers, renovation of 30% of existing facilities, and near-universal 4G/5G coverage.[47]

AI is central to Rwanda's transformation. The country's AI-powered CHW training platform, launched in 2025, personalizes learning for over 58,000 community health workers, improving service delivery and reducing training costs by up to 50%. This complements the broader national AI policy developed in partnership with the Centre for the Fourth Industrial Revolution, which positions Rwanda as a continental leader in ethical and scalable AI deployment. Together, these initiatives reflect Rwanda's commitment to building a resilient, equitable, and tech-enabled health system, one that not only improves outcomes but also empowers its workforce and citizens to thrive in a digital era (Figure 1).[47]

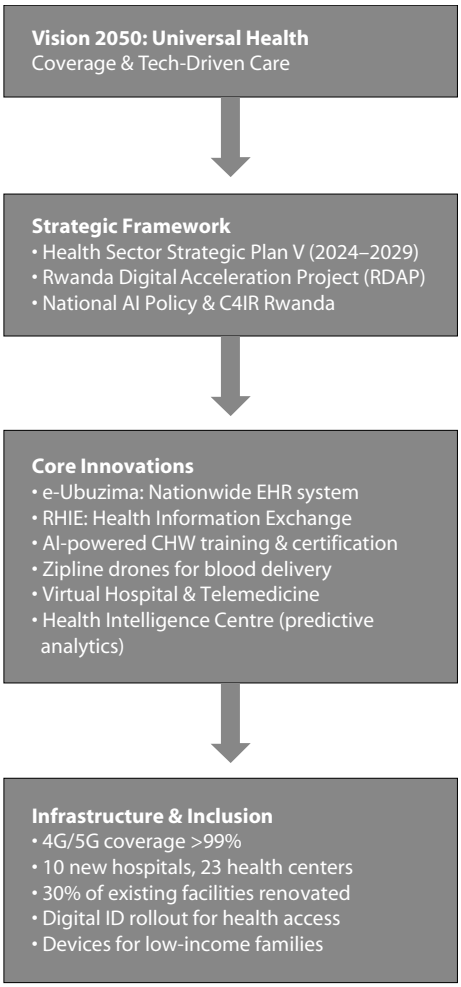

Figure 1 Innovation pathway and strategic prospects for Rwanda's digital health vision[47]

Comparative Insights With Other African Nations

Digital health is rapidly evolving across Africa, with several countries making notable strides in leveraging technology to improve healthcare delivery.[55] Rwanda's experience offers a valuable lens through which to explore regional trends, and its progress is comparable to efforts in peer nations.

For instance, Kenya has made significant progress in digital health, especially in mHealth and EMRs. The Ministry of Health has implemented digital platforms such as Afya KE and developed partnerships with the private sector. However,

challenges remain in achieving nationwide interoperability. Similarly, Nigeria has initiated EMR adoption and mHealth programs like the Smart Health Information Platform, although infrastructural and funding limitations often affect their scale and continuity.[48] Rwanda's implementation of OpenMRS and e-Ubuzima faces similar barriers, although it benefits from centralized coordination under a national digital health strategy.[49]

In terms of health logistics, Rwanda, Ghana, and Malawi have each adopted drone technologies to improve access to essential medical supplies. In Ghana, Zipline delivers vaccines, blood, and medications to over 2,500 health facilities. Rwanda's model is comparable and notable for its integration within public health systems. Both models are viewed as innovative but face questions about long-term financial sustainability.[50]

Regarding telemedicine, countries such as Ethiopia, Uganda, and Tanzania have launched mobile-based health services, including remote consultation platforms and SMS-based health education tools. These initiatives are tailored to underserved populations and supported by development partners. Rwanda's deployment of AI-enhanced services such as Babyl is noteworthy, but similar technologies are being piloted in Nigeria and Kenya, where virtual consultations and AI triage are emerging.[51,52]

All these countries share common barriers. These include limited internet connectivity, gaps in digital literacy, and heavy reliance on external funding. Digital inclusion is a cross-cutting issue, particularly in remote areas where mobile access is inconsistent.[53] In response, countries have developed diverse approaches. Tanzania has emphasized community-based digital education, while Kenya is scaling digital identity systems to support health financing and patient tracking. Similar models are being implemented in Rwanda and Uganda.[54]

While Rwanda has aligned its digital health efforts with national development agendas such as Vision 2050 and the HSSP V, other countries like Ethiopia and Nigeria are also developing long-term digital health frameworks.[56] The regional comparison shows that Rwanda's experience reflects a broader continental movement toward digital transformation, shaped by innovation, adaptive implementation, and shared systemic challenges.

Limitations

This review is based on publicly available literature, reports, and policy documents. Although the narrative approach effectively summarizes Rwanda's digital health progress, it may overlook certain regional or institutional variations. In addition, some sources primarily reflect the perspectives of implementing bodies rather than end users, which could introduce reporting bias. The absence of disaggregated or longitudinal data limited deeper analysis of digital health interventions' clinical impact. Nonetheless, the review offers valuable insights into the current digital health landscape and informs future research, policy, and implementation strategies.

Conclusion

In conclusion, Rwanda has made significant progress in leveraging health information technologies and digital health services to improve data management, healthcare access, and patient-centered care, especially in geographically dispersed areas, to achieve UHC. The adoption of EHR systems, telemedicine, and mHealth applications has enhanced access to high-quality healthcare. Rwanda's digital health efforts are evolving toward patient-centered care, focusing on improving healthcare accessibility, data management, and cost-effective service delivery. Despite ongoing challenges in integrating health information technology, digital health initiatives in Rwanda have strong potential to transform healthcare delivery and improve patient outcomes in the future.

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Teaching Medical English to Non-Native Speakers Involved in Healthcare: A Review of Challenges, Practical Solutions, and Implications

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Abstract

Background Teaching medical English to non-native speakers presents challenges that go beyond standard English language instruction. These include specialized medical vocabulary, complex syntax, and the crucial role of culturally appropriate communication in healthcare settings. Such factors can negatively impact learning outcomes and the quality of patient care.

Objective This review aims to identify the key challenges faced by non-native speakers in learning medical English and explore practical, evidence-based solutions to address these obstacles.

Methodology This is a narrative review conducted to review the various literature concerning medical English teaching for non-native speakers. PubMed, Google Scholar, and Web of Science were used for the database searching, and over 100 articles were downloaded for the general screening.

Results The review showed that vocabulary complexity, syntactic intricacies, pronunciation, and cultural communication significantly hinder non-native speakers' proficiency by 75%, 65%, 70%, and 60% in medical English, compared to 30%, 25%, 40%, and 20% in general English, respectively, for non-native speakers. Key practical solutions identified include the implementation of several approaches, such as immersive learning experiences, peer-assisted learning, targeted phonetic training, and culturally sensitive communication strategies. This has been shown to enhance the learning process and improve patients' interactions in healthcare settings.

Conclusion Addressing the challenges of teaching medical English to non-native speakers requires unique educational frameworks and tailored instructional methods. Implementing these solutions is crucial for enhancing healthcare communication, ensuring patient safety, and fostering effective patient interaction with healthcare providers.

Keywords medical English, non-native speakers, linguistic challenges, health education, pedagogical framework

Introduction

Medical English is an essential skill for healthcare professionals worldwide in facilitating communication with patients, professional documentation, and collaborative practices between healthcare professionals. Unlike general English, medical English includes specialized vocabulary and syntax, which makes it more complex, mainly for non-native speakers. Challenges associated with learning medical English, especially to non-native speakers, extend beyond those of general English. Firstly, vocabulary complexity is a major hurdle, as medical English integrates complex terminologies mainly from Greek and Latin words, making comprehension and pronunciation more difficult for non-native speakers. For example, terms like hepatomegaly, cholecystectomy, splenomegaly, and hippopotomonstrosesquippedaliophobia are uncommon in general English and require an understanding of etymological roots, which are unfamiliar to many learners. In addition, syntactic variations in medical English, such as the use of passive voices and nominalization (eg, administration of medication vs. to administer medication), become complex too. In comparison to general English, these linguistic intricacies require more tailored teaching approaches that specialize in individual learners' needs.

Moreover, medical English necessitates proficiency not only in its terminology but also in healthcare communicative norms. For instance, non-native speakers must become adept at culturally sensitive communication, which includes patient-centered dialogues and empathy, useful for building relationships and trust in clinical interactions. Studies have

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shown that most speakers struggle with adapting their language to match the communicative expectations of medical settings regarding precision and conciseness, which markedly differ from conversational English norms. Pronunciation is also another hurdle, particularly with terms of Greek and Latin origin, when minor errors can change the meaning, for example, words "urethra" and "ureter".

This review will investigate contemporary methodologies in the instruction of medical English for non-native speakers by examining the challenges encountered by non-native medical English speakers, and will also provide strong solutions to those challenges, along with future directions and recommendations for improvement.

Methodology

This article reviews different studies to identify the problems and solutions for medical English teaching for non-native speakers. We collected various papers from different databases, such as PubMed, Google Scholar, and the Web of Science, for the review. Over 100 articles were downloaded for the general screening regarding the objectives of the article. Some of the keywords used were 'Medical English,' 'Medical teaching,' 'Non-native speaker,' 'Medical education,' and 'English Pedagogy.'

This is a narrative review of different articles which connect with medical English. The inclusion criteria for the downloaded article were Systematic Review, Meta-Analysis, English papers, and published between 2015 and 2024. The extraction of the data was more precise on the theme of the paper. No formal quality assessment or risk-of-bias analysis was performed, as is typical for narrative reviews.

Results

Possible Effective Teaching Solutions

Teaching medical English to non-native English speakers is quite challenging because of the special vocabulary in medicine, varied educational backgrounds, complex syntax, and contextual fluency. These challenges often require innovative, tailored solutions that facilitate both language acquisition and its effective applications The approaches discussed below combine techniques, digital tools, tailored instructions, collaborative learning, and assessment for developing technical and practical language skills essential in medical English education.

Compensation for medical English facilitators has proven highly effective in meeting each learner's needs. Specifically, tailored programs focus on medical terminologies, clinical expressions, and idiomatic phrases. Tailored medical English programs play a crucial role in medical English education to non-native speakers, focusing on learners' needs in the context of healthcare communication. The primary role of a tailored program is to emphasise medical terminology that enhances pronunciation and addresses comprehension challenges for non-native speakers. Furthermore, tailored programs incorporate immersive learning techniques that stimulate real-life medical scenarios. By exposing students to clinical scenarios, such as patient interaction and communication, these tailored programs enhance the practical skills of learners. For example, role-playing allows learners to practice communicating diagnoses and treatment options in a safe environment, and this helps to build their confidence and fluency.

Immersive learning techniques, such as simulation-based education, improve medical English education for non-native speakers. By participating in simulated clinical scenarios, learners practice their language skills in a context that mirrors real-life medical scenarios. For instance, students role-play as nurses conducting a preoperative assessment, requiring them to communicate effectively with patients and build capacity and confidence in future real-life situations in their medical career. The benefits of using immersive techniques lie in their ability to improve vocabulary retention and build confidence and adaptability among learners. Through more practice in language skills using those simulations, students are more likely to remember and apply vocabulary and enhance their medical English level, to be practiced in their healthcare roles.

The integration of technology in medical English education has revolutionized learning experiences, especially for non-native speakers. The development of learning apps, online courses, and virtual reality (VR) simulations creates a supportive environment for learners. These tools are valuable in medical English education, as they provide well-tailored exercises making the acquisition of medical vocabulary and communication skills more effective. One of the advantages of using education-based tools in learning is the ability to offer instant feedback. Unlike traditional classes where learners wait for feedback for many days, the technology works instantly. Practicing online quizzes, exercises, and questioning gives immediate responses to your work, which helps learners to learn quickly and effectively.

The incorporation of VR simulations into medical English education represents a significant leap in immersive learning. These simulations allow students to be in a realistic environment with patient interaction and communication, and they make students confident and more adaptable. Moreover, VR enhances nonverbal communication, which is very crucial in a medical career. Using VR in medical English education develops communication, adaptability, and confidence in medical students.

In medical English education, regular assessment and feedback are essential for effective medical English education, especially for non-native speakers. Formative assessments

and exercises help to identify learners' challenges and promote a growth mindset. Self-assessment tools further encourage learner autonomy and investment in their education.

Pedagogical Approaches and Frameworks

In today's interconnected world of globalization, English has become the predominant global language in many countries, which poses challenges for non-native speakers. In the medical field, these challenges affect not only personal communication but also the interactions between healthcare providers and patients, as well as clinical outcomes. To help non-native English speakers improve their medical English skills, several strategies (Figure 1) have been proposed. These include participating in verbal exercises, attending one-on-one sessions with faculty members, joining academic writing support workshops, and utilizing interactive computer simulation materials.

The integration of AI in healthcare, especially in the area of learning medical English, has emerged as a valuable solution. This integration within medical education represents a significant advancement in addressing the linguistic communication challenges faced by healthcare professionals worldwide, particularly for non-native English speakers. AI-driven platforms in English Language Teaching (ELT) have shown improved learning outcomes, teacher efficiency, and accessibility, although ethical considerations like data privacy must be addressed. Their integration with VR/AR (Augmented Reality) technologies creates a highly realistic medical training environment where learners can practice both their language skills and clinical competencies in simulated scenarios that closely mimic real-world situations. It enables learners to navigate through diverse medical conversations, diagnoses, and patient interactions, thereby enhancing their communication with the global health center. They utilize a sophisticated algorithm to introduce, practice, and reinforce specialized vocabulary, ensuring that learners are well equipped to understand and engage in professional medical discourse.

The advent of AI in education presents a promising avenue to address not only medical language proficiency but also some cross-cultural difficulties with experience that go beyond traditional class boundaries among professionals. It stimulates complex medical scenarios, teaches cultural nuances, and offers practice in medical terminologies in English, underscoring its value. That dual effect is essential for non-native English speakers to deliver patient-centered care in increasingly diverse societies. Such AI integration and training equip medical staff with skills to recognize and respect cultural differences, employ culturally appropriate communication strategies, and provide care that acknowledges and honors patients' cultural backgrounds. Successful AI implementation in healthcare requires a risk-adjusted policy framework, privacy-centered technology infrastructure, and quantifiable medical and economic impact measurements. AI applications in healthcare have demonstrated improved outcomes, support for caregivers, and cost reductions, with a projected 28% global compound annual growth rate.

Additionally, peer-assisted learning (PAL), also termed peer education, has become another approach that is effective in teaching medical English. It involves exchanging knowledge between people who are at similar stages in their academic education. It is constructive in numerous aspects of medical education. It has been utilized successfully for teaching certain medical skills such as basic life support, basic surgical skills, and medical terminologies, and also, according to the different studies conducted, it has been perceived by participants to be appropriate and beneficial. In their study, Al Shihabi et al. found a significant increase in participants' confidence level (P value $< .001$) in using medical English in their daily conversations and other medical settings (presenting and discussing cases, writing clinical reports, interviewing patients, and reading English medical texts). Participants not only understood the terminologies but were also able to explain them to their peers during their presentations using simple terms. The same study has also shown that participants' knowledge of terminologies and abbreviations of medical English significantly increased with a substantial improvement in participants' confidence in using English in real-life medical settings, such as in case presentations and discussions.

Task-based language teaching (TBLT) focuses on the completion of real-world tasks as a means of language learning. In the context of medical English learning for future healthcare professionals, it involves designing language tasks that simulate authentic healthcare situations, such as patient consultations, medical interviews, and case presentations. Through this approach, students develop medical language skills while also acquiring the necessary communication strategies for effective healthcare interactions. On the other hand, content-based instructions (CBI) integrate language learning with subject matter content, making language acquisition more meaningful and relevant for future medical workers. In teaching English to aspiring healthcare professionals, CBI incorporates medical topics, vocabulary, and terminology into language lessons. Studies have demonstrated that CBI can be more effective than traditional methods like the grammar translation method in improving students' language achievement and learning orientation. By learning English in the context of healthcare, students gain both language skills and medical knowledge simultaneously, which enhances their ability to communicate effectively in medical settings.

Discussion

Challenges in Medical English to Non-Native Speakers

Teaching medical English to non-native speakers involves several challenges, including linguistic barriers, cultural and communication norms, and practical challenges and others.

One major barrier is that most of the specialized vocabulary comes from Latin and Greek, which makes comprehension difficult for learners. For example, terms such as etymological roots are psycho-pharmacology and the enteric system, which require a deep understanding of their etymological roots to understand them better, which are not found or used in general English. This lexical complexity, with the complexity of syntactic forms such as passive voices and nominalization, creates complex challenges mainly for non-native English speakers. Medical English employs unique syntactic forms, especially for passive voices and nominalization like "Management of the patient's condition" vs. "To manage the patient's condition", which differ from general English. These syntactic features are not only grammatically difficult but also require moderate to high cognitive processing, making them more complex for non-native English speakers to master and study.

Pronunciation also became a notable obstacle. Mispronunciation changes the meaning in a clinical context, particularly with similar-sounding medical terms. For instance, confusing the ureter and urethra, pancreas and pylorus, and liver and lymph nodes could potentially lead to clinical errors. This challenge is intensified by the phonetic complexity of Greek and Latin terminologies used in healthcare settings. Research studies highlight that non-native speakers need additional training in phonetics to improve their medical terms.

Beyond linguistic challenges, cultural and communication norms became one of the big challenges for medical English for non-native speakers. Medical English does not only require language proficiency but also needs patient-centered communication practices, which may be in contrast to those of learners' cultural backgrounds. This includes the need for empathy, culturally sensitive approaches, and clear language. Studies show that most non-native English speakers face discomfort and uncertainty when adapting to the foreigners' norms, as their native culture may differ in professional interaction and communication. Adapting to these cultural and communication norms, such as in direct patient engagement and communication, became another challenge for non-native English speakers.

Practical constraints, including limited resources and instructional support, also complicate medical English for non-native speakers, especially in developing countries. Many programs, particularly in low-resource settings, lack qualified instructors who are fluent in both English and medical terminology, impacting the language instruction. Additionally, limited access to contextualized resources, such as patient case studies and clinical scenarios, which are essential for practice and applications, is often limited, mainly in developing countries. Reviews show that institutions face practical constraints mainly on funding and technology, limiting their ability to create a good environment for learners. The lack of modern teaching tools, including digital resources and language labs, reduces opportunities for learners to engage fully in the practical elements of medical English.

Addressing all of these challenges requires an integrated approach that recognizes linguistic, practical, and cultural aspects of medical English instructions. The four aspects highlight the need for intervention for the provision of future generations with no communication problem either in studying or in medical service provision. Figure 2 highlights these challenges, presenting a comparison between general and medical English complexities.

Challenges in Implementation

Worldwide, English is a language that is needed in different situations, mostly as a globalization tool, where it is used as the first language in speaking and communication. English is crucial in the daily life of the medical journey, particularly in class, where students use it in their medical class as the medium of instruction (mostly in course materials, assignments, tests, and other activities) and in their communication with others. This implies different results, mostly in medical English education programs, starting from students to instructors. Different studies discussed the various challenges in teaching medical English to non-native speakers, mostly in the implementation of this common understanding.

The medical profession is a profession in the way of practices and curriculum structure that is made up of a huge medical terminology (jargon) that is unique compared to other schools. This also allows students to be highly independent and is not always what the facilitator explains or their notes. Students need to do research in different books to come up with their understanding and develop their own way of thinking. This is also applicable to non-native speakers in teaching and learning the medical English language.

Medical English teaching in some universities and hospitals is still a challenge in the implementation because of a shortage of time in the curriculum structure, a shortage of qualified instructors, insufficient teaching materials, a lack of supporting projects, and a high abundance of usage of familiar languages in class. All these cause the pedagogy of teaching medical English to non-native speakers to become more difficult, as detailed in Table 1.

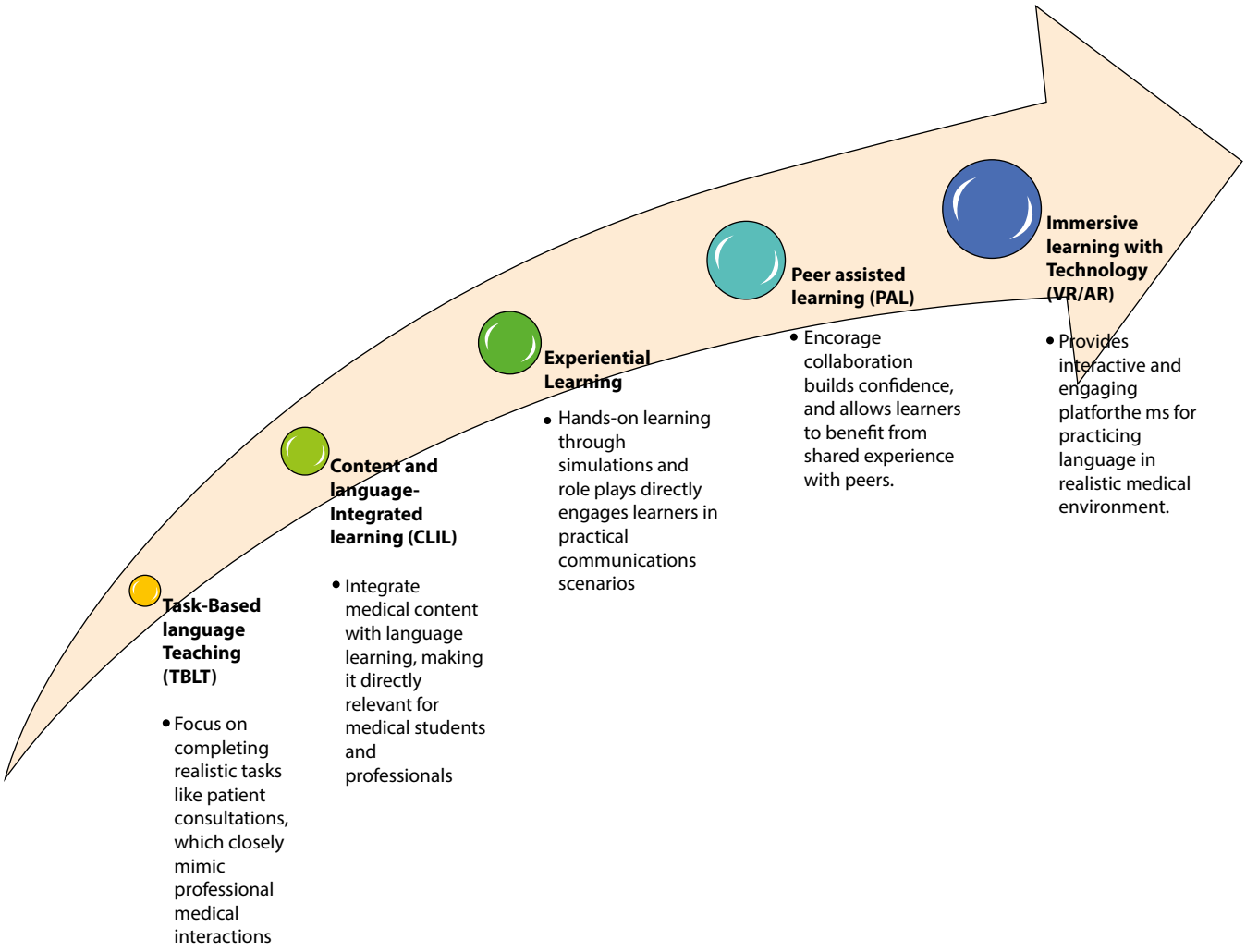

Figure 1 Commonly used pedagogical frameworks for teaching medical English to non-native speakers

Medical students use English in their clinical placement and other academic activities, which affects their performance when discussing with patients. Some countries do not focus on these implementation obstacles, and obviously, this affects much in the service delivery in the hospital and hospitality, in the learning of medical students, and also in the productivity of medical students in the fitness of market opportunities.

Recommendations

Medical English teaching is one of the tools for the future development of medicine. This starts in the class by applying a strategy called 'Need Analysis.' The teacher stimulates the students, prepares curricula, and allows students to express what they know in English to make them develop effective strategies. These strategies emphasize the autonomy of learners in gaining their knowledge about different aspects of English, such as speaking and writing in English for their medical careers.

Peer teaching through increased speaking practice is an effective approach for students. In this method, the teacher creates a comfortable and safe educational environment to learners, provides access to role models, and enhances intrinsic motivation to study.

Additionally, as the world is entering the digitalization of different sectors, education is not left behind. There is a new project that is effectively supporting students in learning medical English. For instance, in China, smart classes are used to teach modules instead of traditional methods.

Further research is needed to address the significant gaps in the current knowledge regarding the teaching of medical

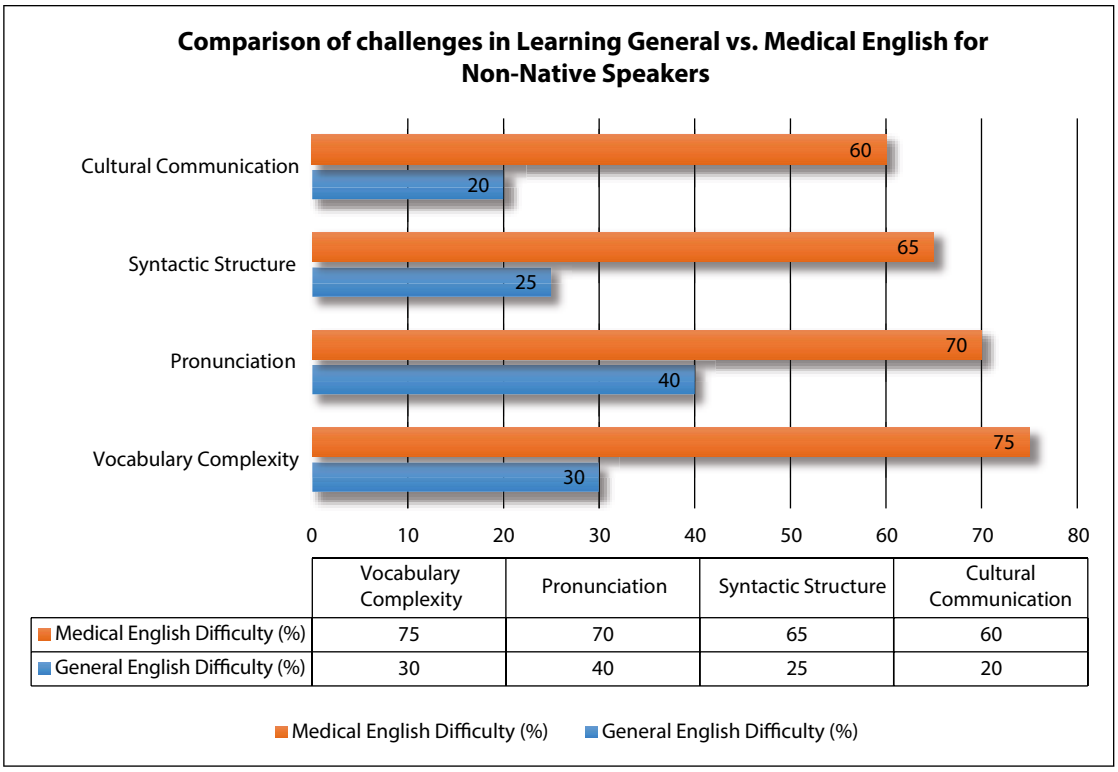

Figure 2 Comparison of challenges in learning general vs. medical English for non-native speakers.

Table 1 A breakdown of challenges by institution type (medical schools, hospitals) and resource availability

Institution Type	Resources Level	Challenges in Implementation
Teaching Hospitals	Low resources	Some studies indicate that hospitals in the United States receive a high number of patients who are not English speakers, and this affects the medical and dental students in a clerkship or ward round.
Medical School (Students and Instructors)	Low resources	An abundance of using familiar language/native language: native language speakers are used to teaching in their mother language, and this causes difficulty for non-native speakers to get what the instructor is teaching. The lecturers did not participate in the interactive sessions that help students to develop their English, particularly their speaking skills, which are often needed in the daily life of medical students.
Medical School (Medical Students)	Low resources	Non-native medical students face negative outcomes, and also, they also do not know the supporting tools they can use. Some research states that the students are more consistent in the usage of their mother tongue in their problem-based learning sessions than when using English, and this helps them to explain their points. Some students are nervous about using English in their communication with others in the small group due to the fear of making mistakes in speaking, and a shortage of grammar or vocabulary to use. The author reports that the students are more confident in using their mother tongue during clinical clerkship than in the common language.

English to non-native speakers, such as the capabilities of students and teachers. The ways globalization can provide solutions to teaching medical English also need to be evaluated. In-depth studies, including a statistical review of the level of engagement of students in this program, are required to provide a comprehensive understanding of medical English teaching methods.

There is still a need for future investment, research, and engagement of the lecturers and other stakeholders to develop curricula for general medical teaching.

Conclusion

The advancement of teaching medical English is critical not only for the professional development of non-native speakers but also for the enhancement of patient safety and quality of care in healthcare environments. Future research and educational frameworks should continue to emphasize innovative teaching methods that address the diverse challenges in learning medical English, ensuring that non-native speakers can effectively navigate the complexities of communication in their healthcare journey.

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CASE REPORT

Coronary Stent Infection: A Rare Complication of Percutaneous Coronary Intervention

Harini Anandan and Ajit S. Mullasari

Abstract

Background Since the introduction of coronary stents, less than 40 cases of coronary stent infection have been reported worldwide. Although coronary stent infection is rare, the mortality rate is high. We report the first case of coronary stent infection from our institute, presented as pyrexia of unknown origin.

Case Presentation A 48-year-old male was presented with low-grade fever associated with cough and malaise on the 8th day of the PCI procedure. He priorly underwent a multivessel percutaneous coronary intervention (PCI) at another hospital. He was evaluated elsewhere and treated with antipyretics, but he continued to be symptomatic and failed to yield any conclusive diagnosis. He was referred to a higher center for further management.

Diagnosis and Intervention Post-PCI pyrexia of unknown origin was found with elevated C-reactive protein and leukocytosis, the whole-body positron emission tomography scan showed increased fluorodeoxyglucose uptake in the left atrioventricular groove along the stent, and blood culture grew *Pseudomonas aeruginosa*. He was treated with cefoperazone-sulbactam 3 gm twice daily for 4 weeks, followed by Tab. Ciprofloxacin 750 mg for 2 weeks, and the patient responded clinically. After 2 months, the patient presented with chest pain and underwent a coronary angiogram that revealed left circumflex (LCx) in-stent total occlusion with a pseudoaneurysm. He underwent coronary artery bypass grafting to the obtuse marginal and posterior descending artery. As the tissues could not be delineated, the stent was not retrieved from the LCx. His postoperative period was uneventful, and he did well at 2-year follow-up.

Keywords coronary stent infection, percutaneous coronary intervention, pyrexia of unknown origin, coronary artery bypass grafting, pseudomonas aeruginosa.

Introduction

Percutaneous coronary intervention (PCI) with stent placement is a common and well-established technique for coronary artery disease. Coronary stent infection is a rare complication that is complicated to treat and often associated with high morbidity and mortality.[1] Less than 40 cases of coronary stent infection have been reported worldwide. The foreign body implantation accounts for approximately 45% of nosocomial infections by damaging or penetrating the epithelial or mucosal barriers. These devices can compromise host defense mechanisms and lead to contamination, and therefore support the growth of microorganisms and result in resistant chronic infections or tissue necrosis.[2,3] Patients with stent infection commonly present with fever, chills, and chest pain. The majority of stent infections are associated with pseudoaneurysm of coronary arteries.[4] These infections are resistant to antibiotics and require surgical intervention.

Drug-eluting stents are associated with a higher risk of infection than bare-metal stents because of their antiproliferative effect.[5] The most common pathogens are methicillin-sensitive *Staphylococcus aureus* (MSSA), methicillin-resistant *Staphylococcus aureus* (MRSA), and *Pseudomonas aeruginosa*.[6] Here we report the first case of coronary stent infection in a patient with a recent history of multivessel PCI at another hospital who was evaluated in our institute for postoperative pyrexia of unknown cause.

Case Presentation

A 48-year-old male was presented with a history of fever associated with cough and malaise. He was euglycemic and normotensive, and has underwent PCI with stent to the left anterior descending artery (LAD), left circumflex (LCx) artery, and right coronary artery (RCA). The patient suffered an inferior

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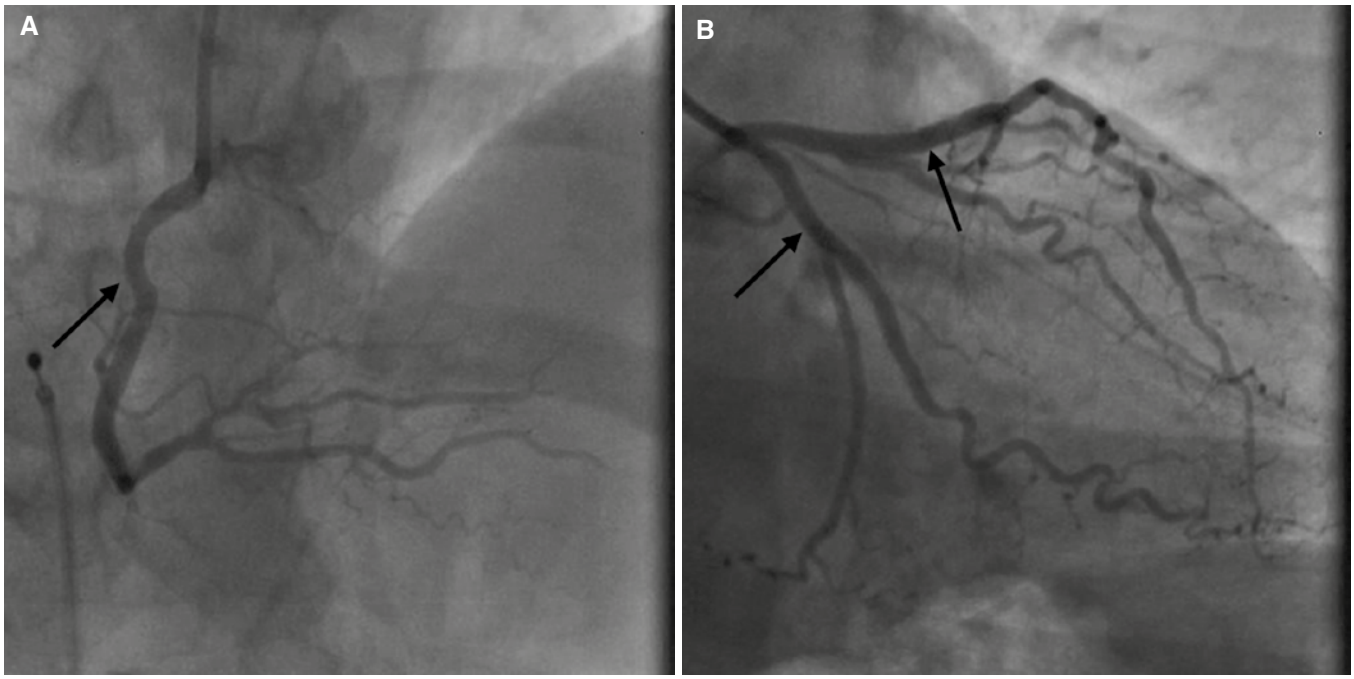

Figure 1 (A and B) Patent stents in RCA, LAD, and proximal LCx artery (black arrows)

wall myocardial infarction 4 months before and underwent primary PCI to RCA using Zotarolimus-eluting coronary stent elsewhere (Figure 1A). After 3 months, he underwent staged PCI to LAD and LCx artery using Zotarolimus-eluting coronary stents (Figure 1B). The hospitalization was uneventful, and he was discharged on the 3rd day. On the 8th day after the procedure, the patient initially developed a low-grade fever with cough and malaise, and he was treated with antipyretics and referred to a higher center.

With pyrexia of unknown origin after PCI with elevated C-reactive protein and leukocytosis, he was advised to undergo further investigations. His positron emission tomography (PET) scan showed fluorodeoxyglucose (FDG) uptake in the left atrioventricular (AV) groove along the stent (Figure 2) with minimal pericardial effusion. Growth of *P. aeruginosa* was observed in blood culture. He was treated with intravenous cefoperazone-sulbactam 3 gm twice daily for 4 weeks, followed by Tab. Ciprofloxacin 750 mg for 2 weeks, and the patient responded clinically. After 2 months of an antibiotic course, the patient complained of chest discomfort, and a repeat blood culture was negative. A repeat PET scan at 1 month showed resolution of FDG uptake in the left

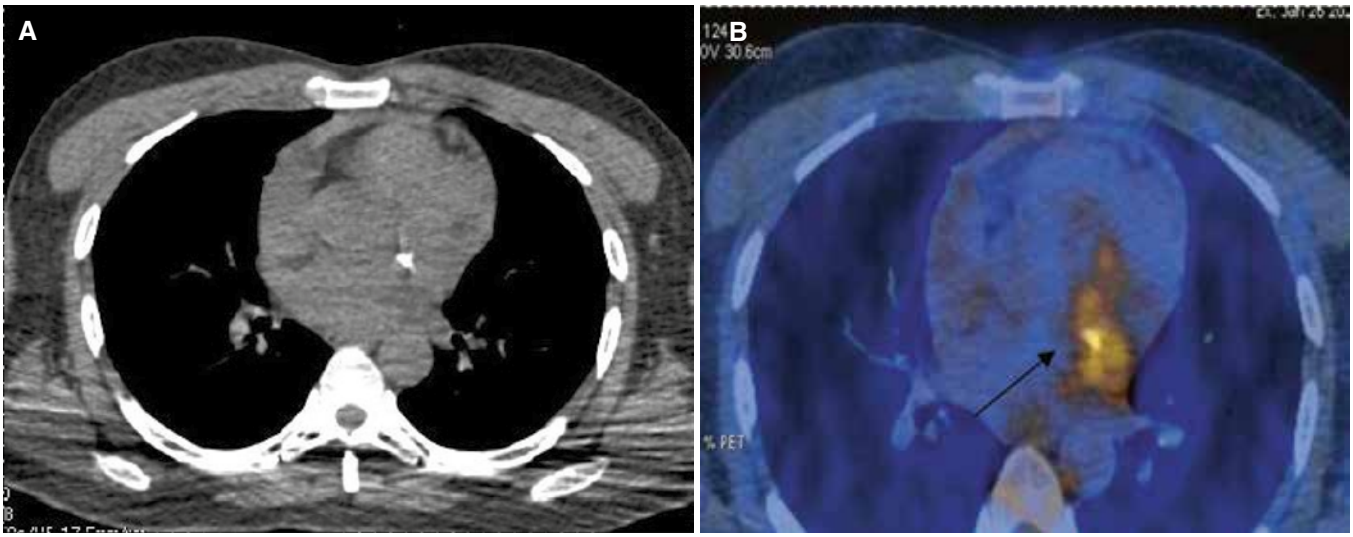

Figure 2 FDG PET scan axial section showing enhanced metabolic activity in the left AV groove along the stent

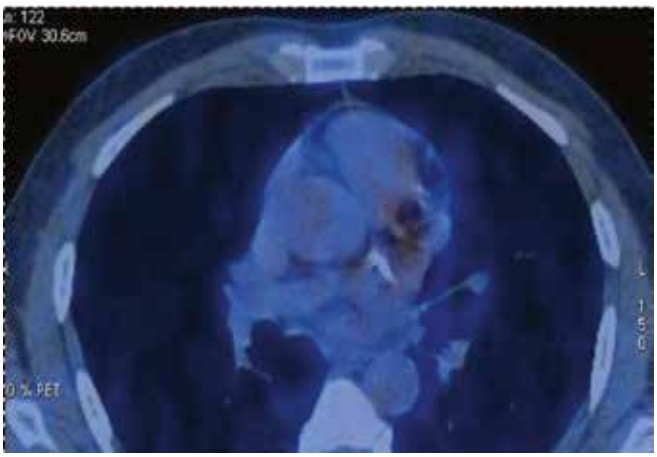

Figure 3 FDG PET scan axial section showing resolution of FDG uptake in the left AV groove along the stent the stent

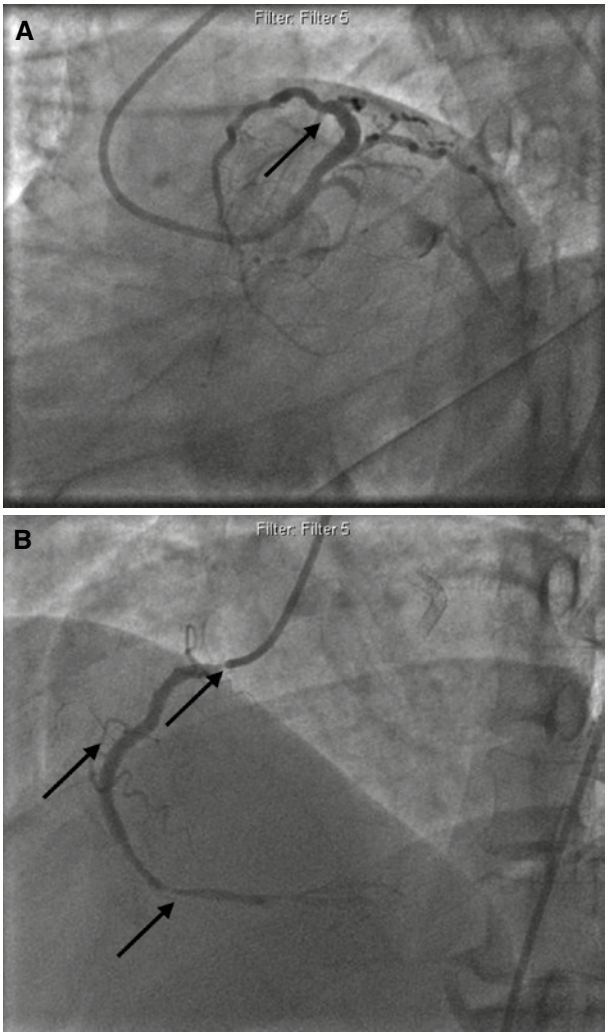

Figure 4 (A) Coronary angiogram showing patent stent in LAD (black arrow) and (B) patent stent in the mid-RCA (black arrow) with ostial and distal disease (white arrows)

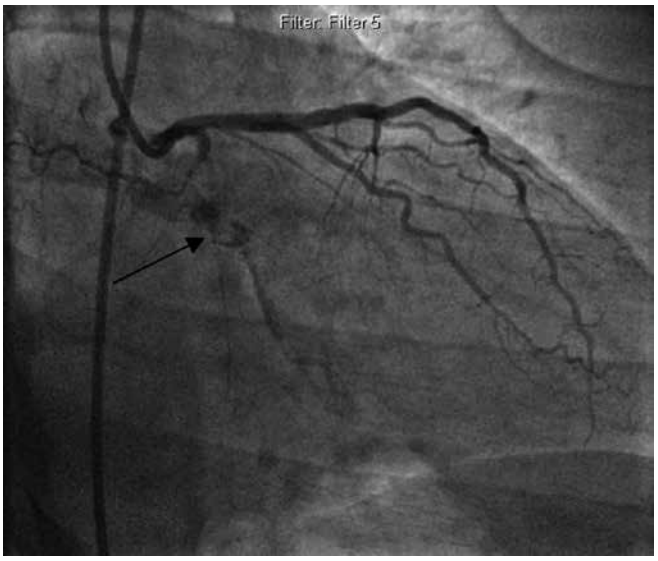

Figure 5 Coronary angiogram showing pseudoaneurysm arising from the LCx artery and in-stent total occlusion (black arrow)

AV groove along the stent (Figure 3). Coronary angiography was recommended to him because of recurrent chest discomfort. After 4 months of staged PCI, he underwent a coronary angiogram, which showed patent stents in proximal LAD and mid-RCA with a significant lesion at the ostial and distal RCA (Figure 4A and B). LCx shows in-stent total occlusion with pseudoaneurysm in the proximal segment (Figure 5). He was advised to undergo early surgical revascularization. During the surgery, severely dense adhesions were noted – Dressler's syndrome. Due to severe inflammation (Figure 6A and B), the tissues could not be delineated, and hence the stent was not retrieved from LCx. A coronary artery bypass graft with saphenous vein to the obtuse marginal and posterior descending artery was performed. The postoperative period was uneventful, and the patient was discharged without complications. At 2-year follow-up, the patient was asymptomatic and doing well.

Discussion

Coronary stent infection was first reported in 1993,[7] and only a few cases have been reported to date worldwide, with *Staphylococcus* species being the most common organism. As it is a rare complication, the diagnosis is often delayed, which results in a high mortality rate of 30.3%.[8] The pathophysiology of coronary stent infection remains unclear. During the procedure, equipment contamination or other remote sources of infection at the time of stent placement can lead to early stent infection.[9] Implantation of a metal stent into a coronary artery can injure the endothelial surface. Endothelial loss may

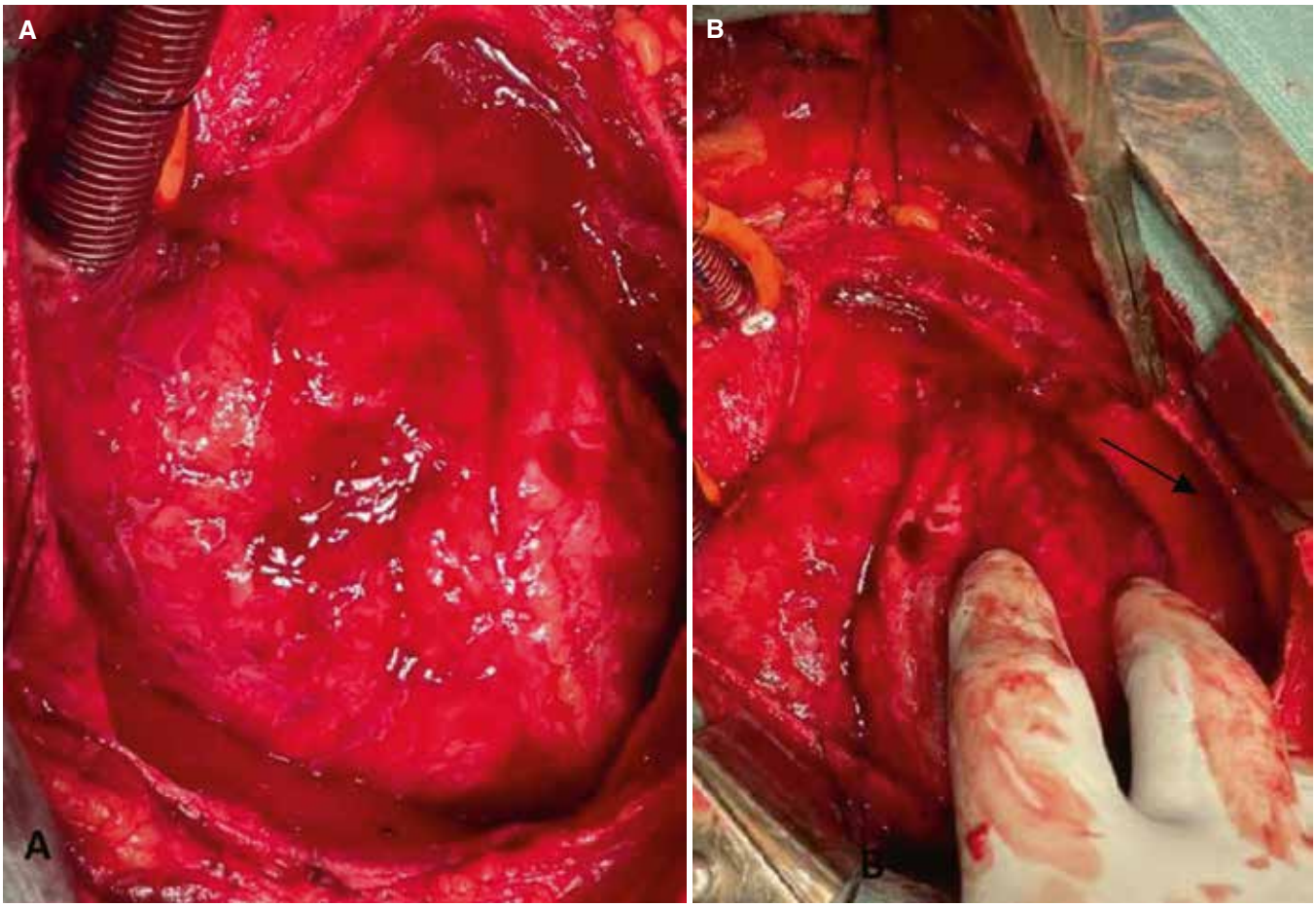

Figure 6 (A) Surgical image with features suggestive of Dressler's syndrome. (B) LCx artery area showing severe inflammation (black arrow)

allow bacteria to enter, and the stent can serve as a nidus for bacteria to adhere.[10] Dieter defined coronary stent infection when three of the following criteria are met: placement of a coronary stent within 4 weeks, repeat procedures performed through the same arterial sheath, fever or leukocytosis with bacteremia without other cause, acute coronary syndrome, or positive cardiac imaging.[11] Although various imaging tools help in the diagnosis of stent infection, PET may be useful when the diagnosis is unclear.[12] The definitive diagnosis is based on the presence of an abscess or inflammatory mass, or an aneurysm or pseudoaneurysm. Coronary stent infection that occurred less than 10 days after implantation is defined as early onset and that occur after 10 days is defined as late onset. All patients with MRSA had late-onset infections, whereas MSSA and *Pseudomonas* had early-onset infections.[5] Bosman et al. reported that these stent infections are associated with high mortality.[9] Early-onset infections respond to medical management alone. Our patient presented with complaints of fever on the 8th day after PCI, and blood culture was positive, showing *P. aeruginosa*. He was categorized as an early-onset infection and responded well with medical therapy. The surgical intervention was required due to progression of the native RCA lesion and LCx in-stent total occlusion, but the LCx stent could not be removed. In patients with pyrexia of unknown cause with a recent history of PCI, stent infection should be considered in the differential diagnosis, and imaging modalities such as PET scan or coronary angiography may aid in diagnosis.

Conclusion

Stent infection should be suspected in patients with pyrexia of unknown origin following PCI. An appropriate antibiotic to cover MRSA, MSSA, and gram-negative organisms should be started. A positive PET scan with the presence of an abscess or an inflammatory mass, or an aneurysm or pseudoaneurysm on the coronary angiogram, confirms the diagnosis.

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CASE REPORT

A Twisting Trail to Diagnosis: Unraveling Morvan's Syndrome in CASPR2-Associated Autoimmune Encephalitis

Yashfeen M.

Abstract

This case snippet describes the diagnostic journey and clinical management of a 72-year-old gentleman who presented with progressive cognitive decline, involuntary myoclonus, and severe insomnia. Through a detailed clinical workup, including electromyography and antibody testing, he was diagnosed with Contactin-Associated Protein-Like 2 (CASPR2) antibody-associated autoimmune encephalitis manifesting as Morvan's syndrome, a rare but reversible neuroimmunological disorder. Prompt initiation of immunotherapy led to gradual improvement, underscoring the value of clinical suspicion, multidisciplinary care, and early intervention. This case serves as a reminder to consider autoimmune etiologies in atypical neuropsychiatric presentations, especially in elderly patients.

Keywords CASPR2 antibody, Morvan's syndrome, autoimmune encephalitis, neuromyotonia, cognitive decline, myokymia, immunotherapy

Introduction

Autoimmune encephalitis involving antibodies against neuronal cell surface or synaptic antigens represents a spectrum of neuropsychiatric disorders, where these antibodies cause direct neuronal dysfunction by binding to specific targets. These conditions may occur with or without malignancy and affect individuals across all ages.[1] CASPR2 antibody–related disorders are rare but treatable neurological conditions with diverse presentations. CASPR2, an autoantigen expressed in both the brain and peripheral nerves, is implicated in a subset of disorders previously classified under Voltage-Gated Potassium Channels (VGKC) antibody syndromes.[2] These can manifest as encephalitis, peripheral nerve hyperexcitability, or both, as in Morvan's syndrome. Morvan's syndrome, named after Augustin Morvan, is characterized by peripheral nerve excitability, autonomic dysfunction, severe insomnia, and variable encephalopathy. Diagnosis is based on detecting specific antibodies in serum or cerebrospinal fluid (CSF). Although recovery may be prolonged, these conditions are often reversible, and many patients respond well to immunotherapy.

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Case Presentation

A 72-year-old gentleman with a known history of hypertension and coronary artery disease presented to the emergency department with altered sensorium and recurrent, involuntary, brief myoclonic movements of the right perioral region and right upper limb, occurring multiple times daily for three months. A year before, he experienced persistent gastrointestinal (GI) symptoms – appetite loss, constipation, and an 8 kg weight loss over three months. Endoscopy revealed a duodenal ulcer, and an elevated Anti-*Saccharomyces cerevisiae* Antibody (ASCA IgG level: 43.1 U/mL) raised suspicion for Crohn's disease. He intermittently used Unani medicine for presumed benign prostatic hyperplasia, consumed alcohol occasionally, and denied tobacco use. Over the past few months, he developed fragmented sleep and insomnia, coinciding with behavioural and cognitive changes: emotional withdrawal, irritability, disinhibition, visual hallucinations, and ultimately, complete dependence for daily activities. At presentation, he was disoriented, spoke irrelevantly and aggressively, and required full assistance with basic self-care.

Examination revealed stable vitals, pallor, and disorientation. Neurologically, he had generalized myokymia and hypokinesia features suggestive of peripheral nerve hyperexcitability, later confirmed on electromyography (EMG). He scored 11/30 on the Mini-Mental State Examination, indicating severe cognitive impairment. A comprehensive series of investigations were undertaken to elucidate the underlying cause.

Electroencephalography (EEG) revealed occasional sharp wave discharges over the frontal, anterior temporal, and parietal regions. Magnetic resonance imaging (MRI) of the brain showed Fazekas Grade 2 white matter hyperintensities, consistent with moderate small vessel ischemia (Figures 1 and 2). Nerve conduction studies revealed mixed demyelinating and axonal polyneuropathy affecting all four limbs, and EMG demonstrated neuromyotonia in all limbs. CSF analysis showed elevated protein levels (161 mg/dL), normoglycorrhachia, and acellular CSF. Importantly, an autoimmune encephalitis workup revealed a positive serum CASPR2 antibody. Laboratory investigations showed normocytic anemia (Hb: 7 g/dL), hyponatremia (Na^+: 128 mmol/L), and markedly elevated inflammatory markers (Erythrocyte Sedimentation Rate: 100 mm/hr, C-Reactive Protein: 147 mg/L). Computed tomography (CT) thorax ruled out thymoma or other paraneoplastic sources. Whole-body PET CT was not performed because of a lack of clinical or laboratory indicators of malignancy and financial constraints.

Based on the clinical presentation and investigative findings, a diagnosis of CASPR2 antibody–associated autoimmune encephalitis was made, consistent with Morvan's syndrome. He was admitted to the intensive care unit and started empirically on IV methylprednisolone. Owing to limited clinical improvement, intravenous immunoglobulin (IVIG) was initiated (0.4 g/kg/day), following cardiology clearance. In parallel, he continued on antiepileptics, cardiac medications, electrolyte correction, nutritional support, and neurological monitoring. Over two weeks, he demonstrated gradual improvement in sensorium, behavior, and motor function. He was discharged with follow-up plans for monthly IVIG infusions at 0.4 g/kg/day for five days per cycle, as part of ongoing immunotherapy, neurology and cardiology reviews, and physiotherapy support, recognizing that recovery in autoimmune encephalitis is often prolonged and may require extended rehabilitation.

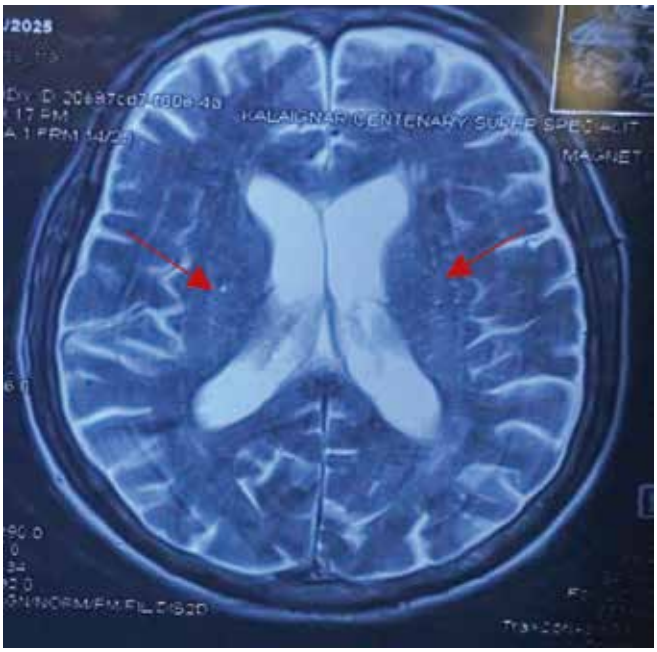

Figure 1 Axial FLAIR MRI showing periventricular and deep white matter hyperintensities (Fazekas Grade 2), consistent with small vessel ischaemia. Findings were nonspecific, prompting further autoimmune evaluation

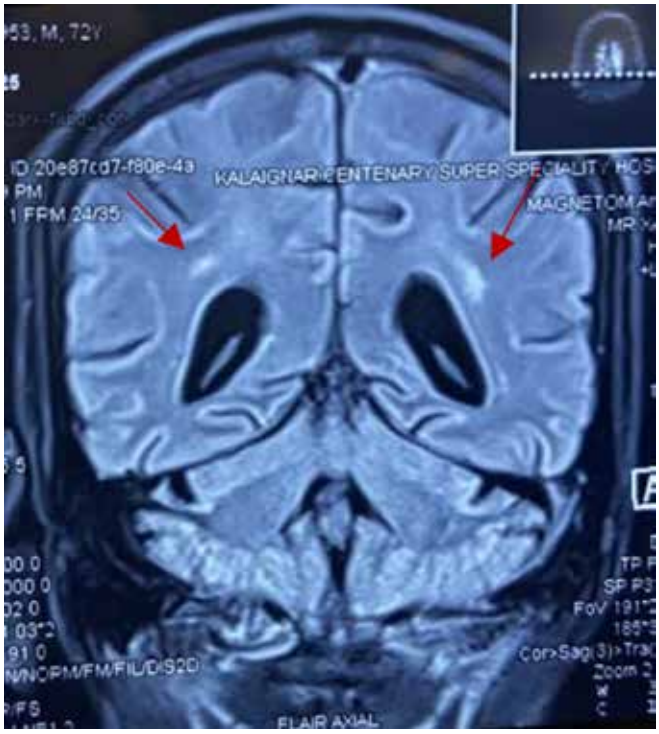

Figure 2 Coronal FLAIR MRI revealing bilateral deep white matter hyperintensities (Fazekas Grade 2), without contrast enhancement. Appearances were not typical of infectious or demyelinating causes

Key Insight/Learning

This case highlights the importance of recognizing Morvan's syndrome, a rare but classic manifestation of CASPR2 antibody–associated autoimmune encephalitis. It presents as a triad of central nervous system symptoms (cognitive and behavioral), peripheral nerve hyperexcitability (myokymia, neuromyotonia), and autonomic dysfunction (e.g., insomnia, hyponatremia). Neuroimaging may be inconclusive or nonspecific, reinforcing the need for clinical suspicion, supportive EMG findings, and serological testing. Labs showing hyponatremia and elevated inflammatory markers can hint at an autoimmune etiology. Early diagnosis and immunotherapy can lead to significant improvement, even in advanced cases. A multidisciplinary approach improves outcomes in such reversible neurological syndromes.

Discussion

Morvan's syndrome associated with anti-CASPR2 antibody encephalitis is a rare but treatable condition, typically affecting middle-aged adults.[3] Its occurrence in elderly individuals is uncommon, making this case of a 72-year-old patient clinically significant. Most case series report a median age of onset in the fifth to sixth decade.[4] Our patient is among the few reported cases in the literature over the age of 70, highlighting the need to consider this diagnosis across a broader age spectrum. Diagnosis is often delayed, as presenting symptoms like insomnia, altered behavior, involuntary movements, and hyponatremia can mimic neurodegenerative, psychiatric, or metabolic disorders commonly seen in older adults.[5]

In our case, GI symptoms and sleep disturbance initially diverted attention from neurological causes. The subsequent progression of cognitive decline, myoclonic jerks, and autonomic instability, along with EMG-confirmed myokymia, prompted evaluation for autoimmune encephalitis. MRI findings were nonspecific, consistent with reports describing mild, focal, or stroke-like changes in CASPR2-associated disorders. Even in elderly patients, immunotherapy has shown favorable outcomes, although recovery may be protracted compared to younger individuals.[6] Our patient improved with corticosteroids and IVIG, reinforcing that age should not preclude immunomodulatory treatment. Clinicians should consider Morvan's syndrome in patients with the characteristic triad of severe insomnia, autonomic dysfunction, and peripheral nerve hyperexcitability, particularly when conventional workup yields inconclusive neuroimaging and metabolic tests.[7] This syndrome often presents with overlapping neuropsychiatric and systemic symptoms, making antibody testing crucial for timely diagnosis.

Conclusion

This case underscores the importance of recognizing Morvan's syndrome in older adults with atypical presentations. Early detection through antibody testing, followed by appropriate immunotherapy, is crucial for achieving an improved prognosis and promoting functional recovery.

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COMMENTARY

Vision 2050: India's Journey to Become a Global Player

Dr. Balasubramanian Mahadevan

Abstract

This study examines India's strategic plan to become one of the top three global economies by 2050 through data-driven analysis and comparisons of economic indicators from 2024 to 2050, utilizing data from trusted sources such as the Reserve Bank of India and NITI Aayog. We analyze India's economic growth in relation to other major emerging economies, focusing on technology, manufacturing, and service sectors. Findings suggest that with strategic policy reforms, investment in innovation, and enhanced infrastructure, India can achieve significant GDP and productivity growth. This article concludes with actionable policy recommendations for local and global stakeholders.

Keywords global economy; GDP; emerging markets; economic growth; technology; manufacturing; services; policy reforms; infrastructure; innovation

Introduction

The global economy is undergoing a rapid transformation, with India emerging as a nation with substantial potential to become one of the top three global economies by 2050. Advancements in technology, manufacturing, and services, along with a large youth population, position India to turn global economic power to its favor. This study investigates India's potential to leverage its resources to achieve this ambitious goal by analyzing key economic indicators and comparing its performance with other emerging and developed economies.[1,2]

By examining macroeconomic trends, sector-specific growth, and global comparisons, this article identifies India's strengths and areas for improvement. As technological advancements, shifting trade dynamics, and urbanization shape the economic landscape, India's policies and infrastructure will play a critical role in its trajectory. This article provides insights for policymakers, researchers, and global investors, focusing on the technology, manufacturing, and services sectors as key drivers of growth. The article is structured as follows: the "Literature Review" section reviews relevant literature, the "Research Methodology" section outlines the research methodology, the "Economic Growth Indicators and Sector Analysis" section analyzes economic indicators and sectoral performance, the "Comparative Analysis with Global Economies" section compares India with top global economies, the "Recommendations and Future Implications" section provides policy recommendations, the "Limitations" section discusses limitations, and the "Conclusion" section concludes with future research directions.

Literature Review

Extensive research exists on economic growth and competitiveness among nations. Barro[1] emphasizes the role of human capital and policy reforms in driving economic growth, in relation to India's post-1990s liberalization.[3] Comparative analyses by Fernandez and Li[4] highlight macroeconomic stability in emerging economies, whereas Patel[5] explores the impact of technology adoption on GDP growth. Johnson et al[6] demonstrate that advanced time series forecasting models, such as Auto-Regressive Integrated Moving Average (ARIMA) and Vector Autoregression (VAR), improve prediction accuracy by accounting for nonlinear trends, which is critical for long-term projections to 2050.

Sector-specific studies, such as the study of Rao and Gupta,[7] discuss about the impact of technological advancements on the productivity of India's service sector, while Bose and Das[8] examine manufacturing resilience through initiatives like Make in India. Despite the existence of abundant literature, there is a gap in integrating sectoral analyses with long-term forecasts to 2050, which this study addresses by combining macroeconomic and sector-specific data with forward-looking projections.[9,10]

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Research Methodology

This study employs a quantitative research design, integrating economic forecasting with sector-specific performance analysis. Time series models, including ARIMA and VAR, are used to analyze data from 2024 to 2050. Data are sourced from reputable institutions, including the Reserve Bank of India, NITI Aayog, International Monetary Fund (IMF), and World Bank, ensuring reliability and consistency. The data are categorized into the following categories:

1. **Macroeconomic Indicators**: GDP growth, inflation, trade balances, and foreign direct investment (FDI).
2. **Sector Performance**: Technology, manufacturing, and services measured by output, employment, and innovation metrics.
3. **Global Comparisons**: Standardized economic parameters for the top 10 global economies.

The methodology accounts for data quality by cross-validating sources and using robust statistical techniques to handle potential outliers and missing data. Projections are based on historical trends and policy assumptions, with sensitivity analyses to address uncertainties.

Economic Growth Indicators and Sector Analysis

This section evaluates India's economic indicators and key sectors from 2024 to 2050. Projections indicate steady GDP growth, declining inflation, and rising FDI, signaling robust economic momentum. Table 1 presents key economic indicators, showing GDP growth increasing from 6.8% in 2024 to 7.5% in 2050, with inflation stabilizing at 3.5% and FDI rising to USD 110 billion by 2050.

The technology sector thrives due to a robust startup ecosystem and increased R&D investment, driving productivity across industries. The manufacturing sector, supported by initiatives like Make in India, demonstrates resilience despite global competition, with policy reforms enhancing export competitiveness. The services sector, the cornerstone of India's economy, benefits from digital transformation and market openness, supported by growing domestic consumption and strategic exports. The interplay of these sectors significantly contributes to India's economic ascent.[7,8]

Table 1 Key Economic Indicators for India, 2024–2050

Indicator	2024 (Projected)	2035 (Projected)	2050 (Projected)
GDP Growth (%)	6.8	7.2	7.5
Inflation Rate (%)	4.5	3.8	3.5
FDI (USD billion)	65	85	110
Export Growth (%)	8.0	8.5	9.0

Table 2 GDP Growth Projections for Selected Economies, 2024–2050

Economy	2024 GDP Growth (%)	2035 GDP Growth (%)	2050 GDP Growth (%)
India	6.8	7.2	7.5
United States	2.2	2.5	2.7
China	5.5	4.5	4.0
Germany	1.5	1.8	2.0
United Kingdom	1.8	2.0	2.2
France	1.6	1.9	2.1
Japan	1.2	1.3	1.5
Brazil	2.8	3.2	3.5
Russia	1.9	2.1	2.3
South Korea	2.7	2.9	3.1

Comparative Analysis with Global Economies

To assess India's potential, we compare its economy with the top 10 global economies based on GDP and innovation capacity, using standardized metrics from the IMF and World Bank. Table 2 shows that while developed nations like the United States and Germany maintain steady growth, emerging economies like India and Brazil exhibit higher growth potential. India's projected GDP growth of 7.5% by 2050 outpaces most peers, driven by demographic advantages and policy reforms. However, infrastructure gaps and regulatory complexities must be addressed to sustain this trajectory.[4]

Recommendations and Future Implications

The findings underscore the need for strategic policy interventions to sustain India's growth. Key recommendations include the following:

- **Digital Infrastructure**: Investments should be made in 5G and broadband connectivity to enhance digital access and support innovation.
- **Manufacturing Modernization**: Regulations should be streamlined, advanced technologies should be integrated, and R&D should be promoted to boost global competitiveness.
- **Services Sector Development**: Skills training should be enhanced to meet evolving job market demands and support service exports.

- **Financial Sector Reforms**: Transparency and stability should be improved to attract sustained FDI.
- **Sustainability**: Environmental and social governance should be prioritized to ensure inclusive and sustainable growth.

These measures can position India as a resilient global economic player while fostering collaboration between government, private sector, and international stakeholders.[9]

Limitations

Long-term forecasting to 2050 is inherently uncertain due to potential disruptions from technological innovations, policy shifts, and global events. Data limitations, particularly in capturing informal economy contributions and emerging industries, pose challenges. Geopolitical tensions and climate change further introduce uncertainties. To mitigate these, the study incorporates sensitivity analyses and cross-validated data sources, but cautious interpretation is advised.[10]

Conclusion

India is well positioned to become a top global economy by 2050, driven by robust GDP growth, sectoral advancements, and favorable demographics. Comparative analysis highlights India's potential to outpace many global peers, provided that it addresses infrastructure and regulatory challenges. The proposed recommendations emphasize targeted investments in technology, manufacturing, and services to sustain this trajectory.[1,3]

Future research should refine these projections by incorporating real-time data and exploring the impact of emerging technologies and global trade dynamics. Collaborative efforts among policymakers, researchers, and stakeholders are critical to navigating India's journey toward economic prominence.

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Commemorative Monograph: Padma Shri Dr. K.M. Cherian – A Life in Cardiac Surgery and Institution-Building

Gomathi Sundar

In the early 1940s, deep in the rolling hills of Munnar, a group of forest-dwelling tribes would occasionally visit the estate town to buy provisions, trading forest produce in exchange. On one such visit, as the group prepared to leave, the tribal chief noticed that the lady of the house was unwell. When she revealed that she was four months pregnant, he made a striking prediction:

A son will be born to you on a Sunday. He will have a mole on his right wrist. One day, he will become a doctor – a doctor who will mend hearts.

This was 1941 – years before cardiac surgery had even entered India's medical vocabulary. The country's first such operation would be attempted only 4 years later. Yet in that moment, in the twilight over Munnar, a future was foretold – one that would eventually change the course of medicine in India.[1]

Dr. Kotturathu Mammen Cherian, known fondly as Dr. K.M. Cherian or KMC, was born the following year, on March 8, 1942, in Chengannur, Kerala. His early years unfolded in the humble rhythms of a small Kerala town,

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where proper schooling was rare, and resources were scarce. Cherian attended a government school with classrooms roofed in coconut thatch that often came loose in the heavy monsoon rains. On many days, the children studied under the shade of mango trees, one tree for each class.[2]

A Curious Childhood

Even as a boy, Cherian's boundless curiosity set him apart. Fascinated by the mysteries of life, he would catch lizards, frogs, and chameleons, carefully cutting them open to peer at the internal anatomy. At just 5 years old, he had already earned a reputation as a little master craftsman, shaping clay into pots, assembling toys for his friends or tinkering with broken household gadgets of his neighbors to restore them to working order. These early sparks of curiosity and dexterity foreshadowed the qualities that would later define him: the steady hands of a surgeon, the inventive spirit of a problem-solver, and the resilience of a pioneer.[1,2]

Training Abroad and the First Bypass

After completing his MBBS and MS in General Surgery at Kasturba Medical College, Manipal, he traveled abroad for advanced training. In Australia and New Zealand, he specialized in cardiothoracic surgery. In Australia he was trained and worked alongside Dr. Tim Cartmill, Dr. Mark Shanahan, and Dr. Rowen Nick. Later, he also trained in the United States under Dr. John Kirklin and Dr. Albert Starr. He underwent training in the leading universities in United States where modern cardiac surgery was evolving.

By June 1975, he returned to India, determined to reproduce these advanced skills under resource-limited conditions. At the Southern Railway Headquarters Hospital, Perambur, Chennai, he performed India's first successful coronary artery bypass surgery. Ironically, he only realized the historic significance when newspapers carried the story the next day.[2,3] This marked the beginning of a career that would change the face of Indian cardiac surgery. The surgery was an audacious feat, accomplished with almost no modern facilities: he operated with a cotton mask, without diathermy, without headlamps, without magnifying loupes, without specialized needle holders or forceps, and with no standby generator. Instead, he relied on a Gigli saw and 7–0 silk sutures coated with liquid paraffin – tools no surgeon would imagine attempting such a procedure with today. For Dr. Cherian, none of that mattered. What mattered was the patient and the urgent need for surgery. His daring in the face of limitations cemented his reputation as one of the boldest cardiac surgeons in Indian medical history. He refuses the label of innovator. "I was the right person in the right place at the right time – with plenty of God's blessing," he says.[2]

Dr. Cherian went on to perform many firsts in Indian cardiac surgery, as summarized in Table 1.

Table 1 Landmark Firsts by Dr. K.M. Cherian

Date	Milestone
June 1975	First successful coronary artery bypass graft in India
Feb 1976	Mitral valve replacement for endomyocardial fibrosis in India
Feb 1976	First use of profound hypothermia and circulatory arrest for correcting cardiac defects in infants in India
Sep 1976	First internal mammary artery graft in the country
Jan 1979	First cardioplegia for myocardial preservation in India
June 1979	Transatrial repair of tetralogy of Fallot
June 1979	First correction of transposition with VSD and pulmonary atresia using an extracardiac conduit
July 1979	First correction of transposition of the great arteries using the Senning technique in India
Oct 1980	First arterial switch operation for TGA with VSD and PDA with a single coronary artery
Mar 1985	First successful bilateral internal mammary artery grafts
June 1988	Homograft aortic conduits for correction of congenital defects
Dec 1994	First transmyocardial laser revascularization (in Australasia)
Sep 1995	First heart transplant in India after the legislation of brain death
June 1997	First bilateral lung transplant in India
May 1999	First autotransplant in India
May 1999	First combined heart and lung transplant in India
March 2010	Double heart transplant in one night
Sep 2011	First pediatric heart transplant in India
Sep 2011	First Levitronix artificial heart (LVAD) implant in India

Source: Multiple.

Abbreviations: TGA, transposition of the great arteries; VSD, ventricular septal defect; PDA, patent ductus arteriosus.

Institution Builder: Madras Medical Mission

Numbers alone cannot capture his contribution – over 47,000 surgeries including the first pediatric heart surgery, the first

heart transplant in a private hospital, the first pediatric lung transplant, and the first heart–lung transplant in India. Equally significant was his role as an institution builder.

Dr. Cherian was instrumental in establishing the Madras Medical Mission (MMM). It began humbly at a rented space in Vijaya Hospital, Chennai, yet even in those early years it attracted children with complex congenital heart disease from disadvantaged countries and the Middle East. Later, in 1995, a purpose-built hospital rose at Mogappair, standing as both a spectacle of beauty and a beacon of hope. Its architecture reflected his refined esthetic taste: biblical-themed paintings along the walls, marble statues including those of Hanuman and Krishna, and a separate multi-faith prayer hall at the entrance. During its construction, Dr. Cherian would visit the site twice every day despite his demanding surgical schedule, ensuring that the building embodied his vision. His esthetic sensibility and respect for all religious traditions were woven into the very fabric of MMM. Beyond its appearance, MMM went on to become the largest tertiary care center in Asia devoted exclusively to cardiac surgery.

Frontier Lifeline

In 2004, barely a month after Frontier Lifeline Hospital opened its doors, its founder Dr. Cherian undertook what few would dare. Together with his team, he performed 20 complex heart surgeries free of cost for destitute Iraqi children, many of whom were brought in with life-threatening congenital heart defects. The Government of India contributed 5 lakhs to support their post-operative care, while the hospital itself bore the costs of surgery and even hosted the Iraqi caretakers of the children during the recovery phase.[4]

The mission was extraordinary not only for its scale but also for its spirit. Destitute Muslim children identified by a Jewish NGO, flown in with help from an American Christian organization, were treated in India by a Christian surgeon – a mosaic of faiths and nationalities united by a single cause: to save young lives.

As the children prepared to return home, the hospital witnessed a poignant farewell. Sri Jayendra Saraswathy Swamigal arrived in person to bless them. Standing alongside him were the legendary actor Kamal Haasan and the Nawab of Arcot, both lending their presence and support as the hospital bid farewell to the children. For the 20 children who left India with mended hearts, it was not only the gift of life they carried home but also the memory of a country and a surgeon who believed that medicine transcends every boundary.

Soon afterward, another crisis tested the reach of Dr. Cherian's voice. Four Indian truck drivers were kidnapped in Iraq. At the request of Mr. E. Ahamed (then in India's Ministry of External Affairs), Dr. Cherian recorded an appeal which was broadcasted to Iraqi authorities and the abductors. In it, Dr. Cherian reminded them that Indians had just performed 20 life-saving heart surgeries free of cost for destitute Iraqi children and urged the hostages' release as a gesture of goodwill. The captives were freed the very next day – an outcome that, whether due to diplomacy or the persuasive moral weight of his plea, underscored the extraordinary authority he commanded far beyond the operating room.[4,5]

Global Recognition and Innovation

Dr. Cherian's stature soon became global. He was the first and only Indian to have his name engraved on a commemorative stone at Kos Island, Greece, the birthplace of Hippocrates, during the World Society of Cardio Thoracic Surgeons meeting.[6]

He also championed innovation. He was among the first to caution that India must prepare for emerging medical technologies, often criticizing bureaucratic red-tapism for stifling research.[7,8] Yet his own practice showed what was possible. In one landmark case, he employed a 3D-printed model of a toddler's heart from Bahrain to plan surgery – a pioneering use of technology in India.[9]

Political Bonds and Public Trust

Dr. Cherian's professional journey often ran in parallel with the political history of Tamil Nadu. His relationship with Dr. M.G. Ramachandran (MGR), the legendary actor-turned-Chief Minister, was particularly close. In interviews, he recounted the moving memory of holding MGR's hand during his final moments and even being entrusted to dictate the leader's death certificate – a responsibility that underscored the profound trust between them.[10]

His bond with J. Jayalalithaa, MGR's political heir and later Chief Minister, was also one of deep mutual respect. He often spoke of her resilience and compassion, "facets that not many had the privilege to see," and acknowledged the pivotal support she extended to his institutions.[11]

Dr. Cherian's reach, however, was not confined to a single political camp. His respect extended across the aisle, including to Kalaignar Karunanidhi, a fierce opponent of MGR and Jayalalithaa. Dr. Cherian admired what he described as the "character, compassion, and vision" of earlier political leaders, qualities he lamented were less evident in contemporary politics (pers. comm.).

The associations ensured that the institutions that Dr. Cherian built (Box 1) had the backing and goodwill they needed to thrive. Beyond Tamil Nadu, Dr. Cherian was personally known to nearly every President and Prime Minister of India during his active decades of service. His voice commanded attention not through partisanship, but through the sheer moral weight of his reputation, his daring surgical feats, and his steadfast commitment to patient care. Beyond his institutional achievements, Dr. Cherian also mentored a generation of cardiac surgeons who today lead premier cardiac centers across India. His influence extended through his students and protégés, multiplying his impact far beyond his own surgical table.

Frontier Mediville: Dr. Cherian's Visionary Science Park

Frontier Mediville was perhaps Dr. Cherian's most ambitious creation, a world-class medical science park conceived not merely as a hospital, but as a futuristic ecosystem blending healthcare, research, education, and biotechnology. Spread across expansive acres in Gummidipoondi on the outskirts of Chennai, Mediville embodied his philosophy that medicine should extend beyond treatment into discovery, teaching, and preservation.[12]

Its design reflected both grandeur and foresight: a state-of-the-art tertiary care hospital, biotechnology and regenerative medicine hubs, training centers for medical and paramedical professionals, and facilities intended to translate ideas seamlessly from bench to bedside. Landscaped gardens, thoughtfully designed interiors, and a quiet spiritual symbolism echoed his belief that science and humanism should coexist on the same campus.

The Heart Museum: Frontier Mediville's Pathology Marvel

Among its star attractions is the Maurice Lev & Saroja Bharati Cardiac Pathology Museum – widely regarded as one of the largest collections of preserved cardiac specimens (over 7000). The galleries display normal and diseased human hearts, components, and comparative animal specimens, along with extensive histopathology slides, transforming the museum into a living classroom for students, trainees, and clinicians (Figure 1).[13]

Legacy of Care and the Physician Associate Profession

Dr. Cherian was not only the father of modern cardiac surgery in India but also the founder of the Physician Associate (PA) profession. In 1992, he launched India's first formal PA

Figure 1 Pathology Museum at Frontier Mediville

Box 1 Institutions developed by Dr. K.M. Cherian (pers. comm., Ms. Sandhya Cherian, Vice-President, Frontier Lifeline Hospital, Vice-President of Frontier Mediville, and daughter of Dr. K.M. Cherian).

1. The Madras Medical Mission, Tamil Nadu
2. Pondicherry Institute of Medical Sciences
3. Frontier Lifeline, Tamil Nadu
4. Frontier Mediville, Tamil Nadu – Medical Bioscience Park
5. St. Gregorios Cardiovascular Centre in Parumala, Kerala
6. Dr. K.M. Cherian Institute of Medical Science in Kallishery, Kerala
7. The Study Le'Cole Internationale, Puducherry (voted as the Best School in Pondicherry several times)

program, later securing academic affiliation with BITS Pilani. Today, nearly 140 institutions across India run PA programs, with an estimated 13,000 graduates – a profession rooted in his vision of team-based healthcare.

He was deeply proud of his PAs. The first few batches were fortunate to be taught directly by the doyen himself. He would personally instruct them during bedside rounds and often in the operating theatre – sometimes even during the waiting periods in surgery when temperatures had to return to normal. Dr. Cherian proudly introduced his PAs to visitors, posed them questions, and beamed with pride when they answered correctly. Fiercely protective, he defended their morale and work with the tenacity of an angry hen shielding her chicks. This unwavering support, while inspiring to his students, also invited jealousy from other healthcare professionals who could not help but notice the affection and trust he placed in his PAs (personal experiences of the author regarding training and protection of PAs by Dr. K.M. Cherian).

Conclusion

Dr. K.M. Cherian's life was a saga of firsts – breaking barriers, building bridges, and turning vision into reality. His story spans prophecy, science, politics, and compassion, yet at its heart lies a simple truth: the true measure of success in medicine rests not in wealth but in the lives saved and the hope kindled. For PAs, surgeons, students, and policymakers alike, his journey remains a lasting testament to vision, perseverance, and humanity. Above all, he was a multi-faceted personality: bold, courageous, and always ready to take the bull by the horns, never accepting defeat even in the face of extreme challenges, embodying the spirit of a phoenix rising from the ashes, qualities that, as much as his surgical skill, defined his life and continue to inspire all who knew him.

Note: No single article can fully contain Dr. K.M. Cherian's legacy. What is presented here can only sketch its outlines. Readers who wish to explore further will find a wealth of material in the references that follow, and the deeper one digs, the more one realizes that his accomplishments do not end.

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