

Health Technology Assessment in Indian Healthcare Decision-Making: A Systematic Review of Status, Importance, and Research Gaps

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ABSTRACT

Objectives: This article attempts to explore how HTA can be helpful in decision-making in Indian healthcare and also to suggest the gaps for which further research is warranted through a systematic literature review.

Methods: After a careful assessment of each record based on the objective and scope of the study, we selected 21 Indian research articles focusing on HTA in the Indian healthcare context for this systematic review.

Results: The comprehensive review reveals: (1) the present status of HTA in India, (2) its importance in healthcare decision-making, and (3) various hurdles in implementation. The study also identifies gaps in current research, providing direction for future studies to better understand and apply HTA in the Indian context."

Conclusions: While Health Technology Assessment provides crucial information for healthcare policy and decision-making in India, it does not make decisions itself. Our review highlights the current status and importance of HTA in Indian healthcare, while also revealing limitations such as limited empirical evidence, oversimplification of complex issues, and assumptions of universal applicability. These findings shape the future research agenda for HTA in India, aiming to enhance its effectiveness in healthcare decision-making.

Keywords: ISPOR (International Society for Pharmacoeconomics and Outcomes Research), Health Technology Assessment (HTA), Ayushman Bharat-Pradhan Mantri Jan Arogya Yojana, Quality Adjusted Life Years (QALYs), Budget Impact Analysis (BIA), Cost Effective Analysis (CEA)

INTRODUCTION

The confluence of technology and health has gained a significant attention in the rapidly evolving domain of healthcare, particularly in India. As the country strives for a more effective and healthful future, the critical analysis of Health Technology Assessment (HTA) becomes crucial in shaping healthcare decision-making processes.

Health Technology Assessment is a systematic, unbiased, and transparent

evaluation of the medical, social, economic, and ethical implications associated with the use of health technologies. In the Indian context, HTA is increasingly recognized as an essential instrument for evidence-based healthcare decision-making. This review aims to explore the current status of HTA in India, its importance in guiding resource allocation and policy decisions, and identify research gaps that need addressing.

The Health Technology Assessment in India (HTAIn), established under the National Health Authority, plays a pivotal role in advancing frameworks and standardized methods for evaluating health technologies. However, the implementation of HTA in India faces unique challenges, reflecting the country's complex healthcare landscape. These include limited availability and inconsistent quality of healthcare data, resource constraints, and the diverse nature of healthcare provision across urban and rural regions.

This systematic review investigates how HTA contributes to informed decision-making in Indian healthcare policy, resource allocation, and improved patient outcomes. It also examines the hurdles in HTA implementation, such as the absence of a defined national policy framework, inadequate stakeholder involvement, and limited understanding among healthcare professionals and policymakers.

By exploring these aspects, this review aims to provide a comprehensive understanding of HTA's role in Indian healthcare decision-making, highlight its importance, and identify critical research gaps. This knowledge is vital for enhancing the effectiveness of HTA in India and ultimately contributing to improved health outcomes and the overall well-being of the population.

OBJECTIVES

1. To explore and analyze the current status and importance of Health Technology Assessment (HTA) in healthcare decision-making processes in India through a systematic review of literature.
2. To identify and highlight research gaps in the field of HTA implementation in the Indian healthcare context, providing directions for future studies to enhance its effectiveness.

METHODOLOGY

This qualitative systematic review of the literature in this study used the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) statement [23]. The researchers followed the guidelines outlined in the PRISMA 2020 Explanation and Elaboration document during the systematic literature review process for comprehensiveness and accurate reporting [24].

1. Identification: Database Scopus used with the single keyword –Health Technology Assessment with Article title (2421)
2. Screening (Inclusion/Exclusion criteria)-
 - a. Year 2000 to 2023 limited to article only
 - b. Publication Stage-Final only
 - c. Country- Limited to India only
 - d. Source type- Limited to Journal only
 - e. Language –Limited to English only
 - f. Access- Limited to Open access onlyAfter using inclusion criteria no of records left-21
3. Quality assessment –No record is excluded as research articles are within the scope with zero duplicates
4. Data extraction- Finally 21 reports are included in the Systematic Literature Review.

This image illustrates the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram, which is a widely used tool for documenting the process of study selection in systematic reviews and meta-analyses. In the context of Health Technology Assessment (HTA), this diagram provides a clear and transparent representation of how studies were identified, screened, and ultimately included in the review. Here's a brief description of the process shown:

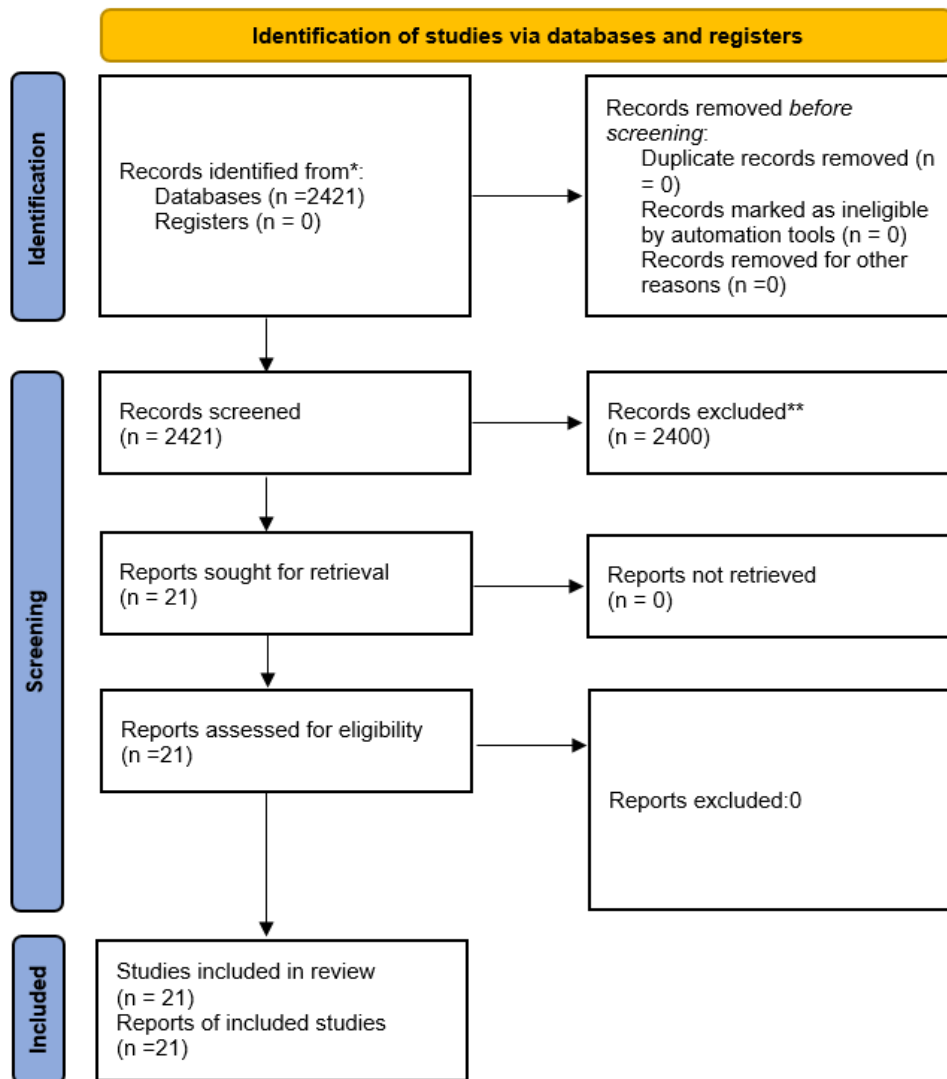


Figure 1- PRISM Flow Diagram

Identification:

- 2421 records were initially identified from databases.
- No records were identified from registers.
- No records were removed before screening for duplication or other reasons.

Screening:

- All 2421 records were screened.

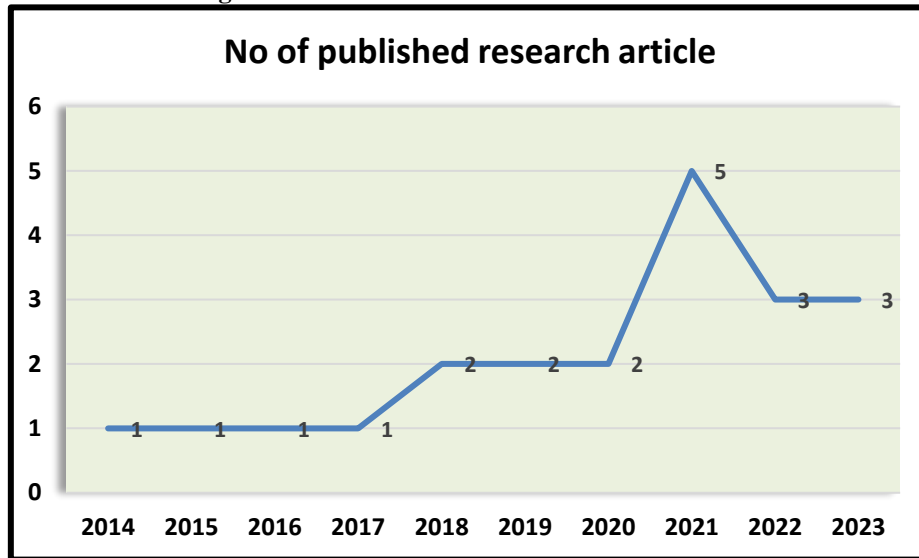
- 2400 records were excluded based on initial screening criteria.
- 21 reports were sought for retrieval and assessed for eligibility.
- No reports were not retrieved or excluded at this stage.

Included:

- 21 studies were ultimately included in the review.
- These 21 reports correspond to the 21 included studies.

RESULTS

Figure 2 – Published Research Article Year-wise

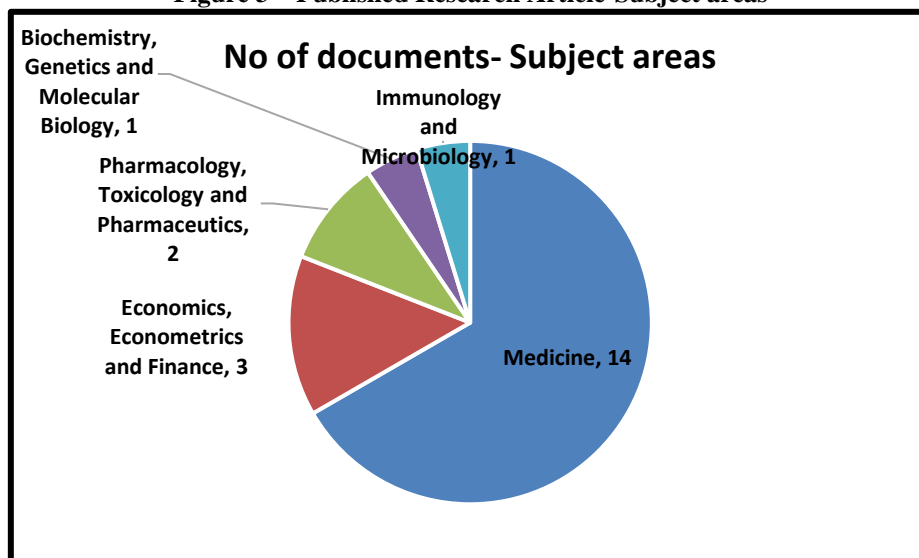


This graph illustrates the trend in published research articles related to Health Technology Assessment (HTA) in India over a 10-year period from 2014 to 2023. The data shows a notable increase in HTA-related publications over time, indicating growing interest and research activity in this field within the Indian healthcare context.

This trend suggests:

1. Increasing recognition of HTA's importance in Indian healthcare decision-making.
2. Growing capacity and expertise in conducting HTA research in India.
3. Possible policy initiatives or institutional support driving more HTA-related studies.
4. A maturing field of HTA in India, with more researchers and institutions engaging in this area.

Figure 3 – Published Research Article-Subject areas



The distribution of documents across these subject areas demonstrates the

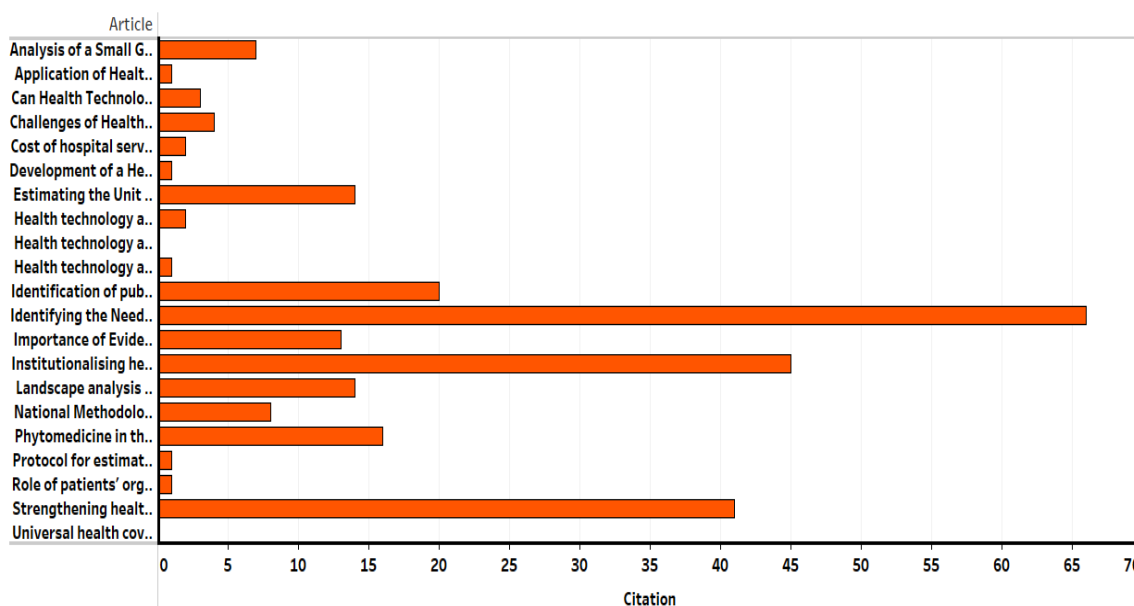
multidisciplinary nature of HTA in India. While medicine dominates, the inclusion of

economics, pharmacology, and other specialized fields shows that HTA is being approached from various angles, reflecting its complex and wide-ranging impact on healthcare decision-making.

This diverse spread of subject areas also suggests that HTA in India is evolving to cover a broad spectrum of healthcare

technologies and interventions, from traditional medical practices to cutting-edge molecular and genetic technologies. It underscores the growing recognition of HTA's importance across different facets of healthcare and related disciplines in the Indian context.

Figure 4 – Published Research Article and their number of citations
Articles and Citations



This graph illustrates the number of citations received by various articles related to Health Technology Assessment (HTA) in India. The visualization provides insights into which topics within HTA are generating the most interest and impact in the research community. Here's an analysis of the data in the context of HTA:

Most Cited Articles:

"Identifying the Need..." is the most cited article with over 65 citations, suggesting it's a seminal work in the field of HTA in India. "Institutionalising he..." and "Strengthening healt..." both have around 40 citations, indicating their significant impact on HTA research and implementation in India.

Key Themes:

Methodological aspects: Articles on "National Methodolo..." and "Estimating the

Unit..." have moderate citation counts, highlighting the importance of developing standardized HTA methods for India.

Economic considerations: "Importance of Evide..." has a significant number of citations, underscoring the relevance of economic evaluations in HTA.

Implementation challenges: "Challenges of Health..." has fewer citations but addresses a crucial aspect of HTA adoption in India.

Emerging Topics:

Some articles with fewer citations, such as "Protocol for estimat..." and "Role of patients' org...", may represent newer or niche areas of HTA research in India that are still gaining traction.

Broad Impact:

The wide range of topics covered by these articles (from methodological issues to

specific applications like phytomedicine) demonstrates the multifaceted nature of HTA research in India.

Policy Relevance:

Articles related to universal health coverage and strengthening health systems have notable citation counts, indicating the strong

link between HTA and broader health policy goals in India.

Practical Applications:

Studies on specific applications like "Health technology a..." (possibly referring to specific technologies) have varying citation counts, showing diverse interest in practical HTA applications.

Table1. The Table showing studies used in this Systematic Literature Review

Author/Title	Synopsis of findings/Conclusion	Thematic ideas
Jain B et al. (2014) [2] Analysis of a Small Group of Stakeholders Regarding Advancing Health Technology Assessment in India	This study concludes that there is a mixed response to implementing HTA in India, but there are factors involved in implementing such tools that can be dealt with using various approaches. The study suggests that there is potential for HTA programs to be implemented in India, but a concerted effort from all stakeholders would be required to build capacities, make investments, and bridge research-policy gaps in evidence-building. The experience of HTA in countries such as Thailand should be leveraged. Finally, there is a positive view on the national level toward pushing the HTA agenda forward to improve the decision-making process in healthcare	1. Potential benefits of using HTA as a tool for informing decision-making, 2. Need for capacity building
Chaudhary T. et al. (2015) [3] Phytomedicine in the treatment of cancer: A health technology assessment	The study evaluates the effectiveness, safety, and cost-effectiveness of phytomedicine as an addition to conventional cancer therapy through a comprehensive health technology assessment. The research emphasizes the socioeconomic implications of cancer treatment and the need for cost-effective interventions to reduce the economic burden on patients and the healthcare system. The study highlights the importance of evidence-based decision-making in cancer care and the role of HTA in informing policy and practice.	1. Cost-Effectiveness of Cancer Treatment 2. HTA can systematically assess the impact of phytomedicine on mortality, adverse events, and cost-effectiveness, providing evidence-based information to support decision-making in cancer care
Dang A et al. (2016) [4] Can Health Technology Assessment (HTA) provide a solution to tackle the increasing healthcare expenditure in India?	The private healthcare system in India, constituting a significant majority of medical facilities and expenditures, is effective but plagued by high costs. With the absence of a comprehensive insurance scheme covering the majority of the population, private healthcare consultations primarily rely on out-of-pocket (OOP) payments, driving many individuals into poverty. This article explores the potential of Health Technology Assessment (HTA) in addressing these challenges.	1. Cost Containment-Insurance-Funded Healthcare Model 2. Organizational and environmental factors 3. Health equity and access
Downey L.E. et al.(2017) [5] Institutionalising health technology assessment: Establishing the Medical Technology Assessment Board in India	The study concludes that institutionalizing HTA in India is crucial for achieving universal health coverage and improving the allocation of health resources. The establishment of a Medical Technology Assessment Board is a promising step towards introducing a more transparent and evidence-based decision-making process. Taking advantage of international collaboration during the formative stage of development could help address various challenges.	1. Institutionalizing HTA 2. International collaboration 3. Complex and fragmented health system architecture

<p>MacQuilkan K. et al.(201) [6] Strengthening health technology assessment systems in the global south: a comparative analysis of the HTA journeys of China, India and South Africa</p>	<p>The analyses revealed that China, India, and South Africa share many barriers to strengthening and developing HTA systems, such as minimal HTA expertise, weak health data infrastructure, rising healthcare costs, fragmented healthcare systems, and significant growth in non-communicable diseases. Stakeholder engagement and institutionalization of HTA were identified as two conducive factors for strengthening HTA systems.</p>	<ol style="list-style-type: none"> 1. Challenges in LMICs in resource allocation due to scarce resources and large disease burdens. 2. knowledge sharing and collaboration 3. institutionalization of HTA
<p>Downey L.et al.(2018) [7] Identification of publicly available data sources to inform the conduct of Health Technology Assessment in India</p>	<p>The formal integration of HTA into India's health policy presents an opportunity to comprehensively assess the availability and quality of health data across the nation. While epidemiological information is routinely collected, significant data gaps hinder the efficient generation and deployment of HTA in health decision-making. Strengthening routine data collection processes to encompass comprehensive and verifiable health data is identified as a crucial step.</p>	<ol style="list-style-type: none"> 1. Quality of health data for HTA 2. OOP expenditure data capture is difficult
<p>Teerawattananon Y.et al.(2019) [8] Landscape analysis of health technology assessment (HTA): systems and practices in Asia</p>	<p>The paper provides several policy recommendations, including considering capacity constraints and governance principles, weighing the benefits and challenges of decision-making authority, and exploring the feasibility of establishing a harmonized HTA system in Asia. It also emphasizes the importance of collaboration among HTA agencies and the need for further research in this area.</p>	<ol style="list-style-type: none"> 1. Stakeholder participation 2. Analysis of decision-making practices
<p>Kristensen F.B.et al.(2019) [9] Identifying the Need for Good Practices in Health Technology Assessment: Summary of the ISPOR HTA Council Working Group Report on Good Practices in HTA</p>	<p>The ISPOR report highlights several best practices for conducting HTA studies, including defining the HTA process, synthesizing evidence, and implementing and monitoring HTA.</p>	<ol style="list-style-type: none"> 1. Conducting HTA studies 2. Boundary of HTA to be defined in context 3. HTA impacts on the development of guidelines and policies for the use of healthcare technologies
<p>Singh G. et al. (2020) [10] Health technology assessment of fixed-dose combination regimen in treatment of newly diagnosed smear-positive pulmonary tuberculosis: A meta-analysis</p>	<p>The study highlights the importance of evidence-based policy decision-making and the need for comprehensive evaluation of FDC regimens in diverse healthcare settings to inform the adoption and implementation of this new health technology.</p>	<ol style="list-style-type: none"> 1. Use of HTA in clinical efficacy 2. Evidence based policy decision
<p>Bahuguna P. et al.(2020) [11] Estimating the Unit Costs of Healthcare Service Delivery in India: Addressing Information Gaps for Price Setting and Health Technology Assessment</p>	<p>The study underscores the importance of cost estimation models for the Indian healthcare system, using econometric methods to determine cost factors and estimate unit costs for each state. The models prove valuable for health technology assessment, budgeting, and forecasting, highlighting predictors such as health service utilization, facility level, and state.</p>	<ol style="list-style-type: none"> 1. Availability of healthcare cost data 2. HTA plays a critical role in providing the necessary cost information for informed decision-making
<p>Gupta N.et al.(2021) [12] Application of Health Technology Assessment</p>	<p>The article emphasizes the potential of HTA to make cancer treatment more efficient, affordable, and equitable, while highlighting the need for institutional support, legislative mandates, and a</p>	<ol style="list-style-type: none"> 1. clinical effectiveness, cost-effectiveness, and ethical considerations.

for Oncology Care in India: Implications for Ayushman Bharat Pradhan Mantri Jan Aarogya Yojana	shift towards a single-payer system to realize this potential in the Indian context.	2. Standard treatment guidelines 3. The HTA Bill
Prinja S. et al.(2021) [13] National Methodological Guidelines to Conduct Budget Impact Analysis for Health Technology Assessment in India	The main findings emphasize the importance of tailored BIA guidelines for the Indian healthcare context, promoting consistency and transparency in conducting and reporting BIA, and the complementary nature of BIA and CEA in informed decision-making.	1. Budget Impact Analysis (BAI) 2. Cost effective analysis (CEA)
Milevska-Kostova N. et al.(2021) [14] Role of patients' organizations in Health Technology Assessment: a Habermasian system and lifeworld perspective	The study concludes that patient involvement in Health Technology Assessment (HTA) is essential for achieving mutual understanding within the deliberative HTA process. Patients' organizations can act as mediating agents between the instrumental rationality of the HTA process and the communicative rationality of the lifeworld represented through patients.	1. Habermas system 2. Patient and public involvement in Health Technology Assessment (HTA)
Dang A. et al.(2021) [15] Importance of Evidence-Based Health Insurance Reimbursement and Health Technology Assessment for achieving Universal Health Coverage and Improved Access to Health in India	The main takeaway from the study on the importance of evidence-based health insurance reimbursement and health technology assessment for achieving universal health coverage and improved access to health in India is the critical need to address the challenges in the Indian healthcare system, such as high out-of-pocket healthcare expenditure, limited insurance coverage, and disparities in healthcare practices.	1. High out-of-pocket healthcare expenditure in India 2. Targeted outreach to vulnerable populations
Menon A.K.et al.(2021) [16] Health technology assessment of telemedicine applications in Northern borders of India	Telemedicine interventions led to successful on-site stabilization of casualties, averting air-transportation efforts, and achieving cost savings in the initial management of casualties. The reduction in air efforts and remote management of casualties supports the scaling up of telemedicine interventions. Telemedicine is an effective investment in terms of both cost savings and quality of care.	1. Telemedicine interventions management of casualties in high-altitude mountainous terrains 2. Exclusion of overhead costs
Patrikar S. et al.(2022) [28] Health technology assessment of varicella vaccine in the Armed Forces	Varicella vaccination strategy in the Indian Armed Forces significantly reduced hospitalization rates and man-days lost, while also demonstrating cost-effectiveness and QALYs gained.	1.Effective supply chain functioning 2. Legal aspects of HTA 3. QALYs one aspect in HTA
Drummond M.F.et al.(2022) [17] Challenges of Health Technology Assessment in Pluralistic Healthcare Systems: An ISPOR Council Report	The main findings include the challenges of conducting and using HTA in pluralistic healthcare systems, variations in the use of HTA, and recommendations for addressing these challenges.	1.Establishing a national focus for HTA 2. Developing uniform HTA methods guideline
Chauhan A.S. et al.(2022) [18] Cost of hospital services in India: a multi-site study to inform provider payment rates and Health Technology Assessment	The study's conclusion underscores the importance of the obtained cost data in informing healthcare decision-making, from budgeting to economic evaluation and price-setting, while also acknowledging the need for further research and considerations of study limitations	1. Heterogeneity in Healthcare Costs 2. Data-Driven Decision Making 3.Cost of Health Services in India (CHSI)

<p>Chugh Y. et al.(2023) [19] Development of a Health Technology Assessment Quality Appraisal Checklist (HTA-QAC) for India</p>	<p>The study recommends the standardization of quality appraisal processes to ensure high-quality Health Technology Assessment (HTA) evidence for policy use in the Indian context. The Health Technology Assessment Quality Appraisal Checklist (HTA-QAC) was developed to capture all vital aspects of an HTA study in terms of conduct, reporting, and quality, and ensure relevance, validity, smooth usability, and practicability.</p>	<p>1. Health Technology Assessment Quality Appraisal Checklist (HTA-QAC) 2. Targeted literature review</p>
<p>Lahariya C.et al.(2023) [20] Universal health coverage in India and health technology assessment: current status and the way forward</p>	<p>The main findings of the paper include the increased importance of selecting and implementing effective technologies and interventions within national health systems, the significant evolution of mechanisms for Health Technology Assessment (HTA) in India,</p>	<p>1. Universal Health Coverage (UHC) 2. Strengthening data collection mechanisms</p>
<p>Chugh Y.et al.(2023) [21] Protocol for estimating the willingness-to-pay-based value for a quality-adjusted life year to aid health technology assessment in India: a cross-sectional study</p>	<p>The paper outlines the methodology that will be used to estimate the willingness-to-pay-based value for a quality-adjusted life year to aid health technology assessment in India.</p>	<p>1.Willingness to pay (WTP) per quality-adjusted life year (QALY) 2. Cost-effectiveness threshold (CET)</p>

Systematic Review Literature suggests following important aspects of current status of Health Technology Assessment in Indian context:

1. **Institutional Framework:** The establishment of the Medical Technology Assessment Board (MTAB) in India is a significant step towards institutionalizing HTA (Downey L.E. et al., 2017). The Health Technology Assessment in India (HTAIn) was founded under the National Health Authority, playing a crucial role in advancing frameworks and standardized methods for evaluating health technologies (implied from multiple studies) [1]. There's a momentum towards creating a national focus for HTA, as suggested by Drummond M.F. et al. (2022).
2. **Policy Integration:** HTA is increasingly recognized as an essential tool for evidence-based healthcare decision-making in India (multiple studies indicate this trend) necessitating integration of HTA into health policy to address issues such as data availability and quality

- across the nation (Downey L. et al., 2018). The study by Lahariya C. et al. (2023) highlights the growing importance of selecting and implementing efficient technologies and interventions within national health systems. Thrust is also given on HTA for guiding resource allocation and policy decisions, particularly in programs like Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (Gupta N. et al., 2021).
3. **Capacity Building Initiatives:** There's a recognized need for capacity building in HTA, as mentioned by Jain B et al. (2014) and other studies which can be potentiated by the international collaboration during the formative stage of developing HTA to address various challenges (Downey L.E. et al., 2017). Efforts are being made to develop uniform HTA methods guidelines (Drummond M.F. et al., 2022). Health Technology Assessment tool, Quality Appraisal Checklist (HTA-QAC) aims to standardize quality appraisal methodologies for HTA in India (Chugh

Y. et al., 2023). There's a focus on improving data collection mechanisms and healthcare cost data availability, which are crucial for effective HTA implementation (Bahuguna P. et al., 2020; Chauhan A.S. et al., 2022).

SLR suggests that India is making progress in institutionalizing HTA, integrating it into policy-making, and building capacity by alleviating the challenges like data quality issues, deficit of trained personnel, and the complexity of India's healthcare system. Health Technology Assessment (HTA) plays vital role in decision-making in the Indian healthcare context by adopting following measures:

1. **Resource Allocation:** HTA is crucial for allocating resources effectively, especially in a country with limited resources and large disease burdens (MacQuilkan K. et al., 2018) and it helps in reducing out-of-pocket expenditure by adopting quality cost-effective technologies (Dang A et al., 2016).HTA provides evidence-based information to support decision-making in high-cost chronic cases like cancer care (Chaudhary T. et al., 2015).
 2. **Policy Formulation:** HTA contributes to a more transparent and evidence-based decision-making process in healthcare policy (Downey L.E. et al., 2017) and it's valuable for developing standard treatment guidelines and informing policy decisions (Gupta N. et al., 2021). HTA helps in combining clinical effectiveness, cost-effectiveness, and ethical considerations in policy-making (Gupta N. et al., 2021).
 3. **Healthcare Technology Adoption:** HTA systematically assesses the impact of health technologies on mortality, adverse events, and cost-effectiveness (Chaudhary T. et al., 2015) and it guides the acceptance and application of novel medical technologies, as seen in the case of Fixed Dose Regimens for tuberculosis treatment (Singh G. et al., 2020). Further HTA has been used to evaluate the effectiveness of various interventions, such as telemedicine in remote areas (Menon A.K. et al., 2021) and vaccination programs (Patrikar S. et al., 2022).
 4. **Cost-Effectiveness Analysis:** HTA provides crucial cost information for informed decision-making (Bahuguna P. et al., 2020) by combining Budget Impact Analysis (BIA) and Cost-Effective Analysis (CEA) to offer a comprehensive understanding for healthcare resource allocation (Prinja S. et al., 2021). HTA helps in estimating the willingness-to-pay for quality-adjusted life years, which is crucial for determining cost-effectiveness thresholds (Chugh Y. et al., 2023).
 5. **Improving Health Equity and Access:** HTA can contribute to making treatments more effective, affordable, and equitable (Gupta N. et al., 2021) and it supports targeted outreach to vulnerable populations and helps in achieving universal health coverage (Dang A. et al., 2021).
 6. **Stakeholder Engagement:** HTA emphasizes the importance of patient participation in the evaluation process, making decision-making more thorough and patient-centered (Milevska-Kostova N. et al., 2021).
 7. **Data-Driven Decision Making:** HTA promotes the use of quality health data for evidence-based policy-making (Downey L. et al., 2018).HTA encourages the development of robust data collection mechanisms, which are crucial for informed decision-making (Lahariya C. et al., 2023).
- HTA plays a vital role in supporting evidence-based, cost-effective, and equitable healthcare decision-making in India, addressing challenges in resource allocation, policy formulation, and technology adoption while promoting stakeholder engagement and data-driven approaches.

The implementation challenges for Health Technology Assessment (HTA) in Indian

healthcare are very cumbersome and can be summarized as follows:

1. **Data Availability and Quality:** Limited availability and inconsistent quality of healthcare data are primary issues in the accurate assessment of technologies (Downey L. et al., 2018). Poor health data infrastructure hinders effective HTA implementation (MacQuilkan K. et al., 2018). Capturing out-of-pocket expenditure data is particularly challenging (Downey L. et al., 2018).
 2. **Resource Constraints:** There's a shortage of skilled personnel such as health economists and researchers (implied in multiple studies). Limited expertise in HTA is a prominent hindering factor for its institutionalization (MacQuilkan K. et al., 2018).
 3. **Complex and Fragmented Health System:** India's mixed healthcare system, with a significant role played by the private sector, complicates HTA implementation (Dang A et al., 2016). The diverse healthcare landscape encompassing both urban and rural regions adds to the complexity (MacQuilkan K. et al., 2018).
 4. **Policy and Institutional Challenges:** The absence of a defined national policy framework contributes to inconsistent application of HTA (implied from multiple studies). There are challenges in integrating HTA into decision-making processes, especially in healthcare reimbursement and policy formulation (Gupta N. et al., 2021).
 5. **Stakeholder Engagement:** Inadequate involvement of stakeholders, including patients, clinicians, and industry, affects the impartiality of assessments (Milevska-Kostova N. et al., 2021) and so there's a need for better stakeholder participation in the HTA process (Teerawattananon Y. et al., 2019).
 6. **Awareness and Understanding:** Limited understanding and awareness of HTA among healthcare professionals and policymakers can lead to resistance in its adoption (implied from multiple studies).
 7. **Methodological Challenges:** There's a need for standardizing quality appraisal methodologies for HTA in the Indian context (Chugh Y. et al., 2023). Developing uniform HTA methods guidelines is an ongoing challenge (Drummond M.F. et al., 2022).
 8. **Cultural and Ethical Considerations:** Balancing societal values and preferences in a diverse country like India poses challenges for HTA implementation (implied from multiple studies).
 9. **Adaptation to Local Context:** Adapting international HTA models to the Indian context faces challenges due to variations in disease patterns, demographics, and healthcare infrastructure (implied from multiple studies).
 10. **Capacity Building:** There's an ongoing need for capacity building in HTA, including training personnel and developing institutional capabilities (Jain B et al., 2014).
 11. **Financial Constraints:** High out-of-pocket healthcare expenditure and limited insurance coverage complicate the implementation of HTA-based decisions (Dang A. et al., 2021).
 12. **Heterogeneity in Healthcare Costs:** Significant variations in healthcare costs across different regions and facilities in India make standardized assessments challenging (Chauhan A.S. et al., 2022).
- These challenges highlight the complex landscape in which HTA is being implemented in India, requiring concerted efforts from various stakeholders to overcome these hurdles and effectively integrate HTA into the healthcare decision-making process.

DISCUSSION

This SLR suggests following key findings regarding Health Technology Assessment (HTA) in Indian healthcare decision-making:

1. **Evolving Institutional Framework:** Establishment of the Medical

Technology Assessment Board (MTAB) and Health Technology Assessment in India (HTAIn) in year 2017 under the Department of Health Research (DHR), Ministry of Health & Family Welfare (MoHFW) marks significant progress in institutionalizing HTA. Gradually HTA is being recognized as an essential tool for evidence-based healthcare decision-making.

2. **Policy Integration:** Integration of HTA into health policy and decision-making processes is in consideration, particularly in programs like Ayushman Bharat. HTA is perceived as crucial for achieving cost effective Universal Health Coverage in India.
3. **Importance in Decision-Making:** Availability of resources is a great matter of concern in India where HTA plays a vital role in resource allocation, policy formulation, and healthcare technology adoption. HTA assists in transparent, evidence-based, and cost-effective decision-making in healthcare.
4. **Capacity Building Initiatives:** HTA can be implemented through capacity building in HTA, including training personnel and developing institutional capabilities. Academy of Hospital Administration (AHA) is playing vital role in conducting training in collaboration with Kalam Institute of Health Technology (KHIT) Visakhapatnam. International collaborations are very much important for understanding and addressing challenges in HTA implementation.
5. **Data Challenges:** Limited availability and inconsistent quality of healthcare data impose significant hurdles for effective HTA implementation. Government is putting efforts to improve data collection mechanisms and healthcare expenditure data availability in the form of National Health Accounts.
6. **Stakeholder Engagement:** Patient participation and stakeholder engagement in the HTA process. Inadequate involvement of stakeholders

affects the comprehensiveness and acceptance of HTA.

7. **Methodological Developments:** Development of tools to standardize quality appraisal methodologies is needed. Health Technology Assessment Quality Appraisal Checklist (HTA-QAC) is tool for effective data collection. Emphasis is being given to develop uniform HTA methods guidelines suitable for the Indian context.
8. **Implementation Challenges:** Complex and fragmented health system architecture complicates HTA implementation as mixed healthcare system is prevalent in India. However limited awareness among healthcare professionals and policymakers poses a challenge to HTA adoption.
9. **Economic Considerations:** India is facing problem of higher out of pocket expenditure in healthcare, HTA is a potential solution for cost-effectiveness in healthcare helping in reduction of out of pocket expenditure. There's a focus on combining Budget Impact Analysis and Cost-Effectiveness Analysis for comprehensive decision-making.
10. **Contextual Adaptation:** Adapting international HTA models to suit India's diverse healthcare landscape, disease patterns, and socio-economic factors remains a challenge.
11. **Research Gaps:** There's a need for more empirical evidence on HTA's impact in the Indian context. Further research is required to address the oversimplification of complex issues and assumptions of universal applicability in HTA.

These key findings highlight the progress made in HTA implementation in India, and also underscoring the challenges and areas requiring further attention and research.

Following actions are recommended for policymakers and healthcare professionals regarding Health Technology Assessment (HTA) policy & practices in India:

1. **Strengthening Institutional Framework:** To enhance the role and

- capacity of the Medical Technology Assessment Board (MTAB) and Health Technology Assessment in India (HTAIn) and a clear national policy framework for HTA implementation across all states may be developed.
2. **Integrating HTA into Decision-Making:** HTA evidence may be used in healthcare policy formulation, resource allocation, and technology adoption decisions. Further HTA findings to be incorporated into the development of standard treatment guidelines and health insurance coverage decisions.
 3. **Capacity Building:** Build a skilled HTA workforce through training programs and international partnerships, focusing on health economics, research, and policy analysis to enhance India's HTA capabilities.
 4. **Improving Data Infrastructure:** Establishing robust health information systems to collect and manage high-quality, standardized healthcare data across the country. Fragmented sectors to be aligned for capturing authentic out of pocket expenditure with real-world evidence.
 5. **Stakeholder Engagement:** Create formal channels for involving patients, healthcare providers, industry, and other stakeholders in the HTA process. Develop guidelines for transparent and inclusive stakeholder participation in HTA.
 6. **Contextualizing HTA Methods:** Adapt and develop HTA methodologies that are suitable for India's diverse healthcare landscape and socio-economic context. Standardize quality appraisal methodologies for HTA studies in India.
 7. **Awareness and Education:** Implement awareness programs about HTA for healthcare professionals, policymakers, and the public. Include HTA concepts in medical and health policy education curricula.
 8. **Addressing Health Equity:** Use HTA to inform policies aimed at reducing healthcare disparities and improving access to care for vulnerable populations. Consider social and ethical implications alongside clinical and economic factors in HTA.
 9. **Promoting Cost-Effectiveness:** Utilize HTA to identify and promote cost-effective interventions, potentially reducing out-of-pocket expenditure. Develop India-specific cost-effectiveness thresholds to guide decision-making.
 10. **Research Agenda:** Prioritize research to fill identified gaps in HTA evidence, particularly in areas specific to the Indian context. Encourage studies on the long-term impact of HTA-informed decisions on health outcomes and healthcare costs.
 11. **Legal and Regulatory Framework:** Develop appropriate legal and regulatory mechanisms to support the implementation of HTA recommendations. Consider legislating the role of HTA in healthcare decision-making processes.
 12. **Technology Assessment in Public Health Programs:** Extend the use of HTA beyond clinical interventions to assess public health programs and health system interventions.
 13. **Monitoring and Evaluation:** Establish mechanisms to monitor the implementation and evaluate the impact of HTA-informed decisions. Regularly review and update HTA processes to be done based on lessons learned and emerging best practices.
- These implications facilitate a comprehensive approach to embedding HTA in Indian healthcare policy and practice, addressing current challenges while leveraging opportunities for improving healthcare decision-making and cost-effective outcomes.
- India is moving in a right direction by adopting and effective implementation of Health Technology Assessment to achieve the objectives of cost-effective Universal Health Coverage yet following research gaps in Health Technology Assessment (HTA) in the Indian healthcare context can be identified:

- 1. Empirical Evidence on HTA Impact:** Limited studies quantifying the long-term impact of HTA-informed decisions on health outcomes and healthcare costs in India. More researches are needed to ascertain the effectiveness of HTA in improving resource allocation and health equity.
 - 2. Contextual Adaptation of HTA Methods:** India is a diverse healthcare system, more researches to be promoted for adapting the international HTA models in Indian context considering the disease patterns, socio-economic factors, cost-effectiveness thresholds and willingness to pay measures.
 - 3. Data Quality and Availability:** Comprehensive studies are needed on improving quality data management for HTA purpose in India and also find out the methods to capture accurate out-of-pocket expenditure across diverse healthcare settings.
 - 4. HTA in Non-Clinical Interventions:** Research gaps are obvious in application of HTA to public health programs, health system interventions and preventive measures in India. More research studies are needed to ascertain the role of HTA in digital health interventions and telemedicine in Indian context.
 - 5. Capacity Building Strategies:** Effective and comprehensive studies are lacking on curriculum development and training methodologies in Indian context. To study the importance of international collaborations on HTA capacity building are paramount importance in present context of India.
 - 6. Implementation Challenges:** Insufficient studies on overcoming barriers to HTA implementation in India's complex and fragmented health system and also more research studies are needed to understand the ways and means for acceptance of HTA among healthcare professionals and policymakers.
 - 7. Ethical and Social Considerations:** There's not enough research on how to include ethical and social issues in health technology assessment (HTA) in India, considering Indian culture. Also, there are few studies on how to balance money matters with social values when making HTA decisions
 - 8. HTA in Private Healthcare Sector:** As in India private healthcare providers are the important players so more studies are required on integrating HTA in private insurance decision-making processes.
 - 9. Methodological Gaps:** Need for more research on developing and validating India-specific HTA quality assessment tools. Limited studies on addressing the oversimplification of complex health issues in HTA methodologies.
 - 10. Real-World Evidence in HTA:** There's not enough research on how to use real-life health information in India's process for deciding which medical treatments are worth using. Also, there aren't many studies looking at how big data and AI could help make these decisions in Indian healthcare
 - 11. HTA in Emergency and Disaster Response:** There isn't much research on how India uses health technology assessment (HTA) to make quick decisions during health emergencies or disasters.
- Further investigations in these identified gaps could significantly contribute to the advancement and effective implementation of HTA in Indian healthcare decision-making

Limitations Of The Study

- 1. Limited Scope of Literature:** The review was restricted to articles indexed in Scopus and published between 2000-2023, potentially missing relevant studies from other databases or time periods. Exclusion of non-English publications may have omitted important insights from regional language studies.
- 2. Focus on Indian Context:** While providing valuable insights into the Indian scenario, the study's focus on India might limit its generalizability to

other developing countries or healthcare systems.

3. **Reliance on Published Literature:** The study relies on published academic literature, which may not capture all ongoing developments, especially recent policy changes or unpublished government reports.
4. **Limited Primary Data:** The study is based on a literature review without primary data collection, which may limit its ability to capture the most current on-ground realities of HTA implementation.
5. **Evolving Nature of HTA:** Given the rapidly evolving nature of healthcare and technology, some findings may become outdated quickly, especially in areas like digital health and telemedicine.
6. **Heterogeneity of Studies:** The reviewed studies may vary significantly in their methodologies and focus areas, making it challenging to draw universally applicable conclusions.
7. **Lack of Quantitative Analysis:** The study primarily offers qualitative insights and may lack quantitative analysis of HTA's impact on healthcare outcomes or economic indicators.
8. **Limited Stakeholder Perspectives:** The review might not fully capture the perspectives of all stakeholders, especially patients and healthcare providers, if these were underrepresented in the literature.
9. **Potential for Subjective Interpretation:** The thematic analysis and identification of research gaps could be influenced by the researchers' subjective interpretations.
10. **Time and Resource Constraints:** The study might be limited by time and resource constraints, potentially affecting the depth of analysis for each included article.
11. **Limited International Comparison:** The study's focus on India might limit comprehensive comparisons with HTA implementation in other countries, potentially missing valuable international insights.

CONCLUSION

Health Technology Assessment (HTA) is increasingly recognized as a vital tool for evidence-based healthcare decision-making in India. The establishment of institutional frameworks like the Medical Technology Assessment Board and ongoing efforts to integrate HTA into policy-making demonstrate significant progress. However, challenges persist, including data quality issues, capacity constraints, and the need for contextual adaptation of HTA methodologies. Despite these challenges, HTA is effective in improving resource allocation, enhancing cost-effectiveness, and potentially reducing out-of-pocket expenditure in the Indian healthcare system.

Future Directions Of Study

- Invest in capacity building programs to develop a skilled HTA workforce.
- Adapt and develop India-specific HTA methodologies and quality assessment tools.
- Conduct empirical studies to quantify the long-term impact of HTA on health outcomes and costs.
- Explore the application of HTA in non-clinical interventions and public health programs.
- Investigate the role of HTA in India's private healthcare sector.
- Develop strategies to improve awareness and acceptance of HTA among healthcare professionals and policymakers.
- Research effective models for incorporating ethical and social considerations into HTA processes.
- Explore the use of real-world evidence, big data, and AI in HTA for Indian healthcare.
- Study the application of HTA in rapid decision-making during health emergencies.

The proposed areas for future research seek to tackle the knowledge gaps and obstacles we've identified. By pursuing these

directions, we may enhance our ability to effectively use health technology assessment (HTA) in India's healthcare decision-making process. Ultimately, this could lead to better health results for people across the country. These research priorities are designed to strengthen the role of HTA in shaping India's health policies. By addressing current limitations, we aim to create a more robust framework for evaluating and implementing health technologies. This improved approach could result in more informed decisions, potentially optimizing resource allocation and improving the overall cost-effective quality healthcare delivery in India.

Declaration by Authors

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