Market Potential and Adoption Willingness for AI-Enabled Cervical Cancer Screening in India

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Background

Cervical cancer is the second most common cancer in Indian women and a leading cause of cancer mortality

Screening coverage in India is critically low, with only 1.9% of eligible women undergoing screening, due to socio-economic and cultural barriers

Traditional screening methods like Pap smears and VIA are limited by the need for skilled professionals and laboratory infrastructure

Artificial Intelligence (AI) offers a transformative solution by automating cytology analysis, reducing dependency on human interpretation, and enabling faster diagnostics

This study investigates the readiness of gynecologists in urban India to adopt AI-based cervical cancer screening tools and evaluates the market feasibility for such technologies

Study Objectives

Primary Objective:

To evaluate the market potential for AI-enabled cervical cancer screening and assess the willingness of gynecologists across major cities (Mumbai, Delhi, Gurgaon, Ahmedabad, Hyderabad, Pune, Noida) to adopt AI-driven screening technologies

Secondary Objectives:

To identify factors influencing adoption including TAT, diagnostic accuracy, cost, and perceived benefits. To determine the expected barriers in the market for AI adoption.

Introduction

***"Cervical Cancer: Preventable and Treatable if Detected Early"* – WHO**

Cervical cancer originates in a woman's cervix – the opening to the uterus from the vagina. It is linked to HPV (Human Papillomavirus) infection, seen in 100% of cases.

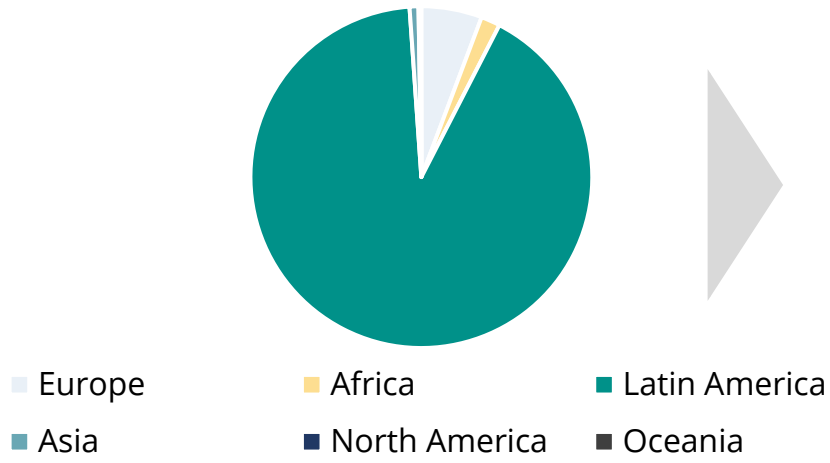
60% of cervical cancer cases are diagnosed at a locally advanced stage.

This reduces the 5-year survival rate to just 7.9%, compared to 73.2% when caught early
WHO states vaccination as primary and screening as secondary most effective preventive measures for cervical cancer

***"One woman dies of cervical cancer every two minutes… Each one is a tragedy, and we can prevent it."* – WHO**

80% of deaths occur in low and middle income countries

Global Burden



- Asia is the epicenter, with 60% of global cases
- India alone accounts for one-third of Asia's cervical cancer burden.
- Every 8 minutes, a woman in India dies due to cervical cancer.
- India accounts for 1 in 4 global cervical cancer deaths (23% of total deaths worldwide).

Vaccinations

- Gardasil
- Cervavac
- Cervarix

Screening Methods

- HPV DNA Testing
- VIA
- Pap Smear Cytology

Key Risk Factors

- Prolonged use of oral contraceptives
- Multiple full-term pregnancies
- Becoming sexually active at a young age
- Poor menstrual hygiene
- Family history of cancer

Symptoms of Cervical Cancer

- Post-coital (after intercourse) vaginal bleeding
- Post-menopausal bleeding
- Intermenstrual bleeding
- Foul-smelling vaginal discharge
- Pelvic pain

Cervical cancer is the 4th leading cause of cancer incidence and mortality among women worldwide

Review of Literature

Title of Study	Author	Key Findings
Cervical cancer awareness and HPV vaccine acceptability among females in Delhi	Jyoti Singh, Brototi Roy, Anshu Yadav, Shumaila Siddiqui, Aarzoo Setia, Ramya Ramesh, Kritika Singh	- 85.11% aware of cervical cancer- 84.6% open to Pap testing - 63.14% would vaccinate their daughters - Low self-acceptance of HPV vaccination highlights cultural and psychological barriers
Factors influencing cervical cancer screening among reproductive age women in India	Jeetendra Yadav, Nilima C., Siddharth Kaushik, Nutan Kumari	- CCS prevalence at just 1.2% - Screening positively associated with education, wealth, and access to care - Emphasized need for policy interventions and awareness at grassroots level
Digital pathology and AI in cervical cancer screening – A global review	Maryam Farahani, Samuel Lundin, et al.	- AI shows promising accuracy in cytology interpretation - Integration challenges include cost, regulatory approval, and infrastructure limitations
Acceptability of AI-Based Tools in Gynecological Practice – A pilot assessment in India	Arvind Rao, Neha Mehta	- 72% showed interest in using AI for LBC - Barriers included lack of training and institutional adoption readiness - Perceived benefits in reducing workload and diagnostic variability

Review of Literature

Title of Study	Author	Key Findings
WHO Global Strategy to Eliminate Cervical Cancer	World Health Organization	- Introduced 90-70 90 goals: 90% vaccination, 70% screening, and 90% treatment - Aimed at reducing cervical cancer incidence below 4/100,000 - Stressed tech-driven solutions for LMICs
Easing the Cervical Cancer Burden in India – The Case for AI-Based Screening	Think Global Health / Council on Foreign Relations	- India's screening coverage remains under 2%- Advocates for AI tools to overcome shortage of cytopathologists - Emphasizes integrating AI with community-based care to ensure rural penetration
HPV Vaccine Implementation in India: Progress and Policy Gaps	ICMR Bulletin	- - Low HPV vaccine uptake despite proven efficacy - Cervavac introduced but not yet in Universal Immunization Programme - Cultural resistance and lack of awareness key limiting factors

Research Methodology

Study Design

Descriptive Cross-Sectional Study

Study Area

Tier 1 cities i.e. Mumbai, Pune, Hyderabad, Delhi-NCR and Ahmedabad

Sampling Technique

Convenience sampling

Sample Size

61 Gynecologists

Inclusion Criteria

Gynecologists practicing in Tier 1 cities

Gynaecologists with atleast 5 years of experience

Exclusion Criteria

Gynecologists who are not involved in cervical cancer screening

Clinics that do not have access to diagnostic technologies

Study Tool

Structured interview with gynaecologists with the help of questionnaire

Data Collection Procedure

In-depth pre - designed questionnaire

Data Analysis Plan- Data was compiled and analysed using MS- Excel

Ethical Considerations- Voluntary Participation, Anonymity and Confidentiality, Right to Withdraw

Analysis and Findings

1 Demographic and Clinical Practice Profile of Respondents [n = 61]

Category	Sub-group	Frequency	Percentage
Years of Experience	> 15 years	34	55%
	6 – 15 years	26	42%
	< 5 years	0	-
Patients seen weekly	>100	11	18%
	51 - 100	18	29%
	<50	32	52%
Screenings per week	>20	15	24%
	10 – 20	21	34%
	<10	25	40%
Screening Method used	Only PAP	4	6%
	Only LBC	38	62%
	Both	19	31%

Insights

Years of Clinical Experience

- 55% of the gynaecologists had over 15 years of clinical experience, indicating a majority of the sample comprises highly experienced professionals.
- 42% had between 6 to 15 years, reflecting strong mid-career representation.
- None had fewer than 5 years of experience, suggesting limited early-career input.

Weekly Patient Load

- 52% of gynaecologists reported seeing fewer than 50 patients per week, indicating a moderate patient throughput for most respondents.
- 29% handled 51–100 patients weekly.
- 18% saw more than 100 patients per week, representing a smaller group with very high patient volumes.

Number of Cervical Screenings Conducted Weekly

- 40% of respondents performed fewer than 10 screenings per week, suggesting that cervical screening is a selective activity within their practice.
- 34% conducted between 10 to 20 screenings weekly.
- 24% reported screening more than 20 patients per week.

Screening Methods Used

- A majority (62%) of gynaecologists reported using Liquid-Based Cytology (LBC) as their primary screening method.
- 31% employed both LBC and Pap smears, indicating a hybrid approach.
- Only 6% relied exclusively on Pap smears

Analysis and Findings

2 Market Potential for AI based Cervical Screening in T1 cities [n = 61]

City	Total Respondents	Response to Adoption-Yes	Readily Interested	% Readily Interested
Mumbai	10	10	8	80%
Hyderabad	10	9	5	56%
Delhi	7	6	5	83%
Gurgaon	7	6	5	83%
Ahmedabad	10	9	6	67%
Pune	10	7	5	71%
Noida	7	6	5	83%

Insights

- **High Overall Adoption Potential:**
  A significant majority of respondents across Tier-1 cities (87% overall) expressed willingness to adopt AI-based cervical screening tools, indicating strong market receptivity.
- **Cities with Highest Readiness:**
  Delhi, Gurgaon, and Noida recorded the highest percentage (83%) of respondents readily interested in adopting AI solutions, reflecting strong readiness in NCR cities.
- **Mumbai Shows Strong Adoption Potential:**
  All 10 respondents from Mumbai indicated willingness to adopt AI-based screening, and 80% were readily interested, placing it just behind NCR cities in terms of enthusiasm.
- **Moderate Interest in Southern and Western Cities:**
  Pune showed a healthy 71% readiness among willing adopters. Ahmedabad followed with 67%, while Hyderabad lagged slightly 56%, the lowest among the surveyed cities.
- **Strategic Focus for Market Entry:**
  Cities like Delhi, Gurgaon, Noida, and Mumbai offer immediate high potential for deployment, while cities like Hyderabad and Ahmedabad may require more awareness-building or value demonstration to increase readiness levels.

Analysis and Findings

3 Willingness to Adopt for AI Based Cervical Screening in T1 cities [n = 61]

City	Total Respondents	Response to Adoption- Yes	% Willing to Adopt
Mumbai	10	10	100%
Hyderabad	10	9	90%
Delhi	7	6	86%
Gurgaon	7	6	86%
Ahmedabad	10	9	90%
Pune	10	7	70%
Noida	7	6	86%

Insights

- **Mumbai** demonstrates universal willingness, with 100% of respondents (10 out of 10) ready to adopt AI-based cervical screening tools.
- This marks it as the most promising launch market for immediate implementation and scale.
- **Hyderabad and Ahmedabad** follow closely, with 90% of respondents in both cities expressing adoption interest. These cities present highly receptive environments, likely requiring minimal effort in clinician education or persuasion.
- The National Capital Region (NCR)—comprising **Delhi, Gurgaon, and Noida**—shows consistent willingness levels of 86%**,** suggesting a broad and uniform openness to innovation among gynecologists in this region. This alignment makes NCR a strategically advantageous hub for multi-city rollout.
- **Pune**, while still showing promise, reflects comparatively lower willingness at 70%, indicating a need for deeper engagement or awareness efforts to build confidence in AI-led screening technologies.

Analysis and Findings

4 Barriers to Adoption of AI-Enabled Cervical Cancer Screening Among Gynecologists

Key Barriers Identified

- Lack of Awareness
- Cost Constraints
- Fear & Anxiety
- Discomfort & Embarrassment
- Stigma & Social Norms
- Misconceptions
- Technical Barriers

Insights

- Gynecologists highlighted a complex range of barriers that hinder patients from undergoing cervical cancer screening.
- The most commonly cited issue was a **lack of awareness**—many women are simply unaware of the need for screening, the availability of tests like Pap smear or LBC, or the risks posed by cervical cancer.
- **Financial constraints** also play a significant role, as many patients view screening as non-essential and are unwilling or unable to bear the costs.
- **Fear and anxiety**—whether related to the disease itself or the clinical procedures involved—further discourage participation.
- **Cultural discomfort** and embarrassment associated with intimate examinations contribute to widespread hesitation, particularly among women in conservative communities.
- **Social stigma** and entrenched gender norms exacerbate the problem, as many women require family approval to access medical care.
- **Misconceptions** about screening, such as the belief that it is only necessary with symptoms or a family history, also act as deterrents.
- Finally, **technical and logistical challenges**, including perceived complexity of the procedures and access to screening facilities, round out the multifaceted obstacles that must be addressed to improve screening uptake.

Analysis and Findings

5 Factors Influencing Adoption- TAT

City	PAP Smear			LBC		
	TAT Range	Average TAT	Mode TAT	TAT Range	Average TAT	Mode TAT
Mumbai	24 to 129 Hours	3.2 Days	1-2 Days	3 to 14 days	8.5 Days	3-7 days
Delhi	24 to 129 Hours	3.2 Days	1-2 Days	3 to 14 days	8.5 Days	3-7 days
Gurgaon	24 to 129 Hours	3.2 Days	1-2 Days	2 to 14 days	8.0 Days	5-7 days
Hyderabad	24 to 129 Hours	3.2 Days	1-2 Days	3 to 14 days	8.5 Days	7-8 days
Ahmedabad	24 to 72 Hours	2.0 Days	1-2 Days	2 to 14 days	8.0 Days	3-7 days
Noida	24 to 129 Hours	3.2 Days	1-2 Days	3 to 14 days	8.5 Days	5-7 days
Pune	24 to 129 Hours	3.2 Days	1-2 Days	2 to 14 days	8.0 Days	5-7 days
Bangalore	24 to 129 Hours	3.2 Days	1-2 Days	3 to 14 days	8.5 Days	3-7 days
Tier 1 Cities		**3.0 Days**	**1-2 days**		**8.0 Days**	**3-7 days**

Insights

- **Faster Turnaround for Pap Smear:** Across all Tier 1 cities, Pap smear consistently shows a much shorter turnaround time than Liquid-Based Cytology (LBC).
- Average TAT for Pap smear is around 3.0 days, while LBC averages 8.0 days, highlighting a significant delay in LBC reporting.
- **LBC Mode TAT Highlights Delays:** Mode TAT (the most commonly reported turnaround) for LBC ranges from 3–8 days, in contrast to 1–2 days for Pap smear in all cities.
- This extended wait time may contribute to lower preference or slower adoption of LBC in time-sensitive clinical decisions.
- **City-Level Differences: Ahmedabad** reported the fastest average Pap smear TAT (2.0 days), likely due to shorter TAT range (24 to 72 hours), indicating better local lab infrastructure or quicker logistics.
- **Hyderabad** shows the slowest mode TAT for LBC (7–8 days), suggesting potential delays or inefficiencies in sample processing.
- **Uniform TAT for Pap Smear:** TAT for Pap smear across cities is relatively consistent (24–129 hours) with 3.0–3.2 days average, indicating a stable system for traditional cytology.

Analysis and Findings

6 Factors Influencing Adoption- Cost

City	Interviews Conducted	Response		
		Yes	Yes (conditional)	No
Hyderabad	10	8	1	1
Delhi	7	2	5	-
Gurgaon	7	5	1	1
Ahmedabad	7	4	2	1
Pune	10	6	2	2
Noida	10	3	6	1
% age		52%	33%	15%

Insights

- **Overall Adoption Readiness is High:**
  85% of gynecologists expressed willingness to adopt the proposed pricing model — 52% unconditionally and 33% conditionally. This indicates strong perceived value for AI-based cytology at this price point.
- **City-Level Positivity Varies:**
  Ahmedabad leads with 80% unconditional acceptance and only 1 rejection, showing a highly receptive market. Gurgaon follows closely with 71% "Yes" responses, signaling strong readiness.
- **Cautious Optimism in Metro Markets:**
  Mumbai (60%) and Noida (57%) reflect moderate interest, suggesting potential for adoption with proper engagement and patient cost alignment.
- **Conditional Acceptance High in Delhi & Hyderabad:**
  In Delhi, only 29% responded “Yes,” but 71% expressed conditional willingness. Similarly, Hyderabad saw 30% “Yes” and 60% “Conditional,” indicating openness if certain criteria—such as efficacy or affordability—are met.
- **Barriers Still Present:**
  15% of respondents said “No,” with notable resistance seen in Pune and Mumbai. This suggests the need to address concerns around trust, process complexity, or perceived value.

Discussion

High Willingness, Variable Readiness

A key outcome of the study is the high willingness (87%) among gynecologists to adopt AI-based screening methods.

- **Mumbai and Ahmedabad** showed both high willingness and readiness, indicating they may serve as ideal pilot locations for rollout.
- **Delhi and Hyderabad,** although open to the idea, exhibited a more conditional stance—emphasizing the need for evidence, training, and assurance on turnaround time (TAT) and diagnostic quality.
- **Pune and Noida** presented moderate adoption potential but reflected concerns about patient volume and integration logistics.

Turnaround Time (TAT) as a Critical Factor

The study found that while Pap smear tests typically have a **TAT of 3.0–3.2 days**, Liquid-Based Cytology (LBC)—the most used method (62% respondents)—takes around 8 days on average. This extended TAT contributes to a potential 10–20% patient dropout risk. AI-based platforms have the potential to improve TAT by streamlining reporting and reducing manual workload. However, **their success will largely depend on**:

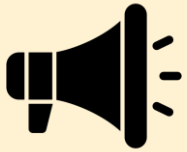
- Efficient logistics and sample transfer
- Real-time access to digital results
- Seamless integration with current lab systems

Other Factors

Cost Sensitivity and Pricing Models: Affordability was a concern on both patient and provider ends, impacting adoption decisions.
52% of gynecologists were open to the Rs. 2000–2500/test pricing, while 33% required institutional or bundled support.
This calls for flexible, tiered pricing and pilot implementations to address variable economic capacities.
Perceived Benefits of AI Adoption: Doctors cited AI's role in reducing human error, improving consistency, and managing diagnostic backlogs. Tele-pathology and remote access were particularly valued in cities facing logistical constraints.
AI was also seen as a tool to enhance patient experience by minimizing repeat procedures and delays.
Barriers to Screening and Adoption: Socio-cultural stigma, low awareness, and family dependence limit cervical screening participation.
Misconceptions and fear around procedures remain prevalent, especially among younger women.

Recommendations

Enhance Awareness Campaigns



Launch targeted awareness programs for both clinicians and patients highlighting the benefits of early cervical cancer screening and the role of AI in improving diagnostic outcomes

Institutional Training and Onboarding

Offer structured training programs for gynecologists, lab technicians, and support staff to build trust in AI-based platforms

Subsidized Pricing Models

Collaborate with public health agencies, insurance providers, and private companies to offer subsidized pricing, improving affordability for patients in both private and public sectors

Recommendations

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Streamline Turnaround Time

Ensure AI systems are optimized to deliver results within the critical 5–8-day window to reduce dropout rates and maintain patient follow-up adherence

Pilot Programs in High-Readiness Cities

Launch demonstration projects in cities like Mumbai, Ahmedabad, and Gurgaon to establish proof-of-concept and build confidence

Integrate with National Programs

Align AI-enabled screening initiatives with existing government frameworks such as NPCDCS to ensure scalability and sustainability

Conclusion

Summary of Findings: AI-Enabled Cervical Cancer Screening in Tier 1 Indian Cities

1. This study evaluated the market potential and adoption readiness of AI-based cervical cancer screening tools among gynecologists across Tier 1 cities in India. Key findings highlight strong interest and readiness, with:

87%

Gynecologists expressing willingness to adopt AI-enabled screening

64%

Identifying strong market potential within their clinical practices

2. **Mumbai, Gurgaon, and Ahmedabad** showed highest willingness to adopt; **Delhi and Hyderabad** showed conditional openness.

3. Top barriers to screening include: low awareness, cost, fear, stigma, and procedural misconceptions.

4. Turnaround Time (TAT) is a critical factor—AI must deliver results in **5–8 days** to prevent patient dropout.

5. **52%** accepted the Rs. 2000–2500/test pricing model; **33% were conditionally agreeable**, needing institutional or pricing support.

6. There is **strong market potential**, provided infrastructural, pricing, and awareness-related barriers are addressed.

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