A STUDY ON AI-DRIVEN DIGITAL CYTOLOGY ADOPTION IN CERVICAL CANCER SCREENING IN TIER-1 INDIAN CITIES: GYNECOLOGISTS' PERSPECTIVES

Dissertation Submitted to

The IIHMR University, Jaipur

for the partial fulfillment for the award of the degree of

Master of Business Administration (MBA)

in

Hospital and Health Management

by

Tapadia Sakshi Suresh

Under the Supervision and Guidance of

Dr. Vidya Bhushan Tripathi

2025

CERTIFICATE

This is to certify that Ms. Sakshi Tapadia in partial fulfillment of the requirements for the award of the degree of MBA Hospital and Health Management from the IIHMR University, Jaipur has successfully completed her/his internship at Healthark Wellness Solutions LLP during 18 March 2025 to 20 June 2025.

Place: Ahmedabad
Date: 20 June 2025

Amol Pandya
HR Manager
Healthark Insights

CERTIFICATE

This is to certify that dissertation titled **A Study on AI-Driven Digital Cytology Adoption in Cervical Cancer Screening in Tier-1 Indian Cities: Gynaecologists' Perspectives** is a record of the research work undertaken by **Dr. Sakshi Tapadia** in partial fulfillment of the requirements for the award of the degree of MBA Hospital and Health Management from the IIHMR University, Jaipur under my guidance and supervision and his/her approach to the research study has been sincere, scientific, and analytical.

Faculty Guide

IIHMR University, Jaipur

Date

School Dean

IIHMR University, Jaipur

Date

1, Prabhu Dayal Marg, Near Sanganer Airport, Jaipur- 302029, Rajasthan, India.
Ph.: 0141-3924700, 2791431- 32, E-mail: iihmr@iihmr.edu.in, Web.: www.iihmr.edu.in

DECLARATION BY STUDENT

I hereby declare that this dissertation titled "**A study on AI-driven digital cytology adoption in cervical cancer screening in Tier-1 Indian cities: Gynaecologists' perspectives"** is the Bonafide record of my original research work.

I declare that it has not been submitted to any other university or institution for the award of any degree or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.

Signature

Dr Sakshi Tapadia

Date – 16/06/2025

Abstract

Title: **A study on AI-driven digital cytology adoption in cervical cancer screening in Tier-1 Indian cities: Gynaecologists' perspectives**

Author Name: Dr. Sakshi Tapadia

Advisor Name: Dr. Vidya Bhushan Tripathi

Keywords: Cervical Cancer, Artificial Intelligence, Digital Cytology, Screening Adoption

Background: Cervical cancer is the second most common cancer among Indian women, contributing significantly to cancer-related morbidity and mortality. Despite national screening programs and growing awareness of HPV vaccination, participation in cervical cancer screening remains limited, mainly due to accessibility issues, lack of awareness, and distrust in current diagnostic methods. Traditional Pap smears are hindered by sensitivity and reproducibility challenges. The introduction of AI-powered platforms like the Genius Digital Diagnostics System offers improved accuracy, consistency, and operational efficiency. Gynaecologists, as primary decision-makers, play an important role in adopting such innovations.

Objectives:

1. To assess the current awareness and understanding of AI-based digital cytology among practising gynaecologists
2. To identify perceived benefits, challenges, and ethical concerns related to the use of AI in cervical cancer screening
3. To explore the infrastructural and training needs required for successful integration of AI-driven digital cytology in urban healthcare settings
4. To provide policy and implementation recommendations for scaling AI-driven cervical cancer screening in urban India

Methodology: A descriptive cross-sectional survey was conducted among 61 gynaecologists from Tier-1 cities including Mumbai, Delhi, Hyderabad, Pune, Ahmedabad, Gurgaon, and Noida. Data was cleaned and analysed using Excel, and results were interpreted and reported.

Results: About 82% of gynaecologists acknowledged their influence in advancing cervical screening. Between 64% and 80% showed readiness to adopt AI-based diagnostics. Key motivators included improved accuracy, reduced error, faster results, and increased patient trust. Barriers included high costs, adherence to conventional methods, and scepticism toward AI.

Conclusion: AI-driven cytology holds transformative potential for cervical cancer screening in India. Strategic efforts in education, cost management, and policy inclusion are vital for broader adoption. Future research should incorporate patient perspectives and clinical outcome evaluations.

Acknowledgement

I am wholeheartedly thankful to Healthark Insights, Ahmedabad, for providing me with a precious opportunity to work alongside them while completing my dissertation project titled “A study on AI-driven digital cytology adoption in cervical cancer screening in Tier-1 Indian cities: Gynaecologists’ perspectives.”

I am also immensely grateful to Dr. VB Tripathi, my mentor, who guided me through the intricacies of the topic, ensuring a thorough understanding.

I extend my sincere gratitude to Dr. Purav Gandhi, Founder of Healthark Insights, for creating a conducive environment and offering optimal guidance, which was instrumental in completion of my work. My appreciation also goes out to my organization mentor, Mr. Yash Somani for his valuable insights.

I must express my deep appreciation to my family and friends who have provided unwavering support and encouragement at every step of this journey.

A heartfelt thanks to one and all for their indispensable support in my academic endeavour.

Dr. Sakshi Tapadia

MBA Health Management

IIHMR University, Jaipur

Table of Contents

List of Figures

List of Tables

Abbreviations

CC – Cervical Screening

CCS – Cervical Cancer Screening

NCD – Non-Communicable Disease

NCRP - National Cancer Registry Programme

HPV - Human Papilloma Virus

LMIC - Low- and middle-income countries

PAP test – Papanicolaou test

LBC - Liquid-Based Cytology

VIA – Visual Inspection with Acetic Acid

WHO – World Health Organization

UIP – Universal Immunization Program

ICMR – Indian Council of Medical Research

DGHS – Director General of Health Services

MoHFW - Ministry of Health and Family Welfare

HIV - Human Immunodeficiency Virus

ICMR - Indian Council of Medical Research

PHC –Primary Healthcare Center

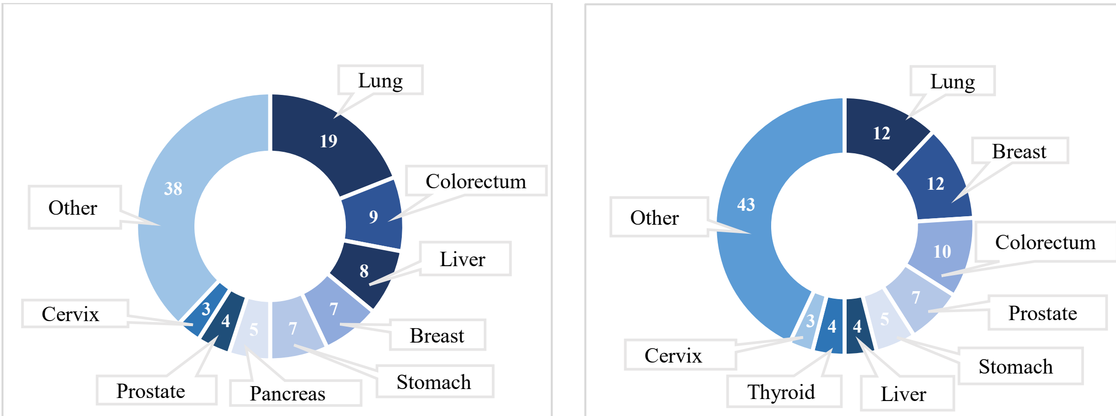
SC – Subcenter

AICCS - Artificial Intelligence Cervical Cancer Screening

Chapter 1: Introduction

1.1 Global Cancer Burden

Cancer as a disease is marked by the uncontrolled proliferation of abnormal cells in any part of the body (WHO,2022). According to the National Cancer Institute, one in five individuals globally are expected to develop cancer at some point in their lives, and one in nine men and one in twelve women pass away from the disease (Cancer Statistics, 2024) (1). GLOBOCAN 2022 reported around 20Mn cancer cases and 9.7Mn cancer related deaths worldwide. Fig1.1 shows the distribution of cancers for both sexes with "Lung cancer leading the list in both incidence and mortality" (Bray et al., 2024a).



a. Incidence

b. Mortality

Fig 1.1 Distribution of (a) Incidence and (b) Mortality for the top cancers in 2022 for both sex

Source: GLOBOCON cancer statistics 2022 (Bray et al., 2024b)

In 2022, women accounted for 9.7 Mn of the 20 Mn newly diagnosed cases and 4.3 Mn of the 9.7 Mn fatalities. Fig1.2 shows the distribution of cancers in women. In terms of both cancer cases and deaths, breast cancer is the most often diagnosed cancer (23.8%) and the primary cause of cancer-related deaths (15%), followed by lung and colorectal cancer (Bray et al., 2024a). CC being the 4^{th} commonly diagnosed and also the fourth leading cause of cancer death worldwide.

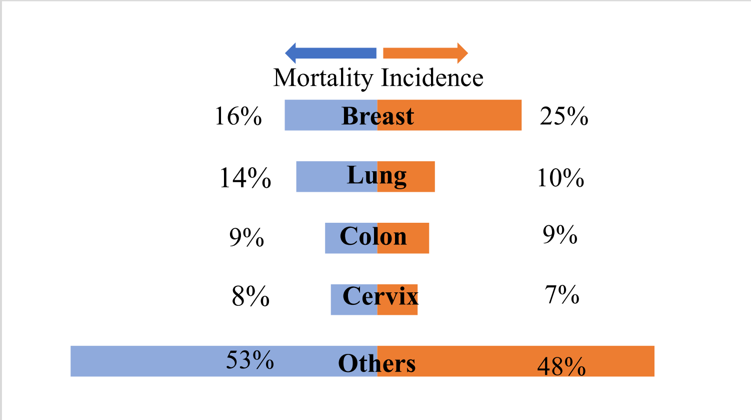


Fig 1.2 Distribution of top most cancers in females (incidence and mortality) (Bray et al., 2024b) Source: GLOBOCON cancer statistics 2022

In developing nations, lifestyle changes, aging populations, and tobacco use have contributed to the increasing prevalence of NCDs, including cancer. This shift highlights the importance of effective policies and advocacy to address this growing health challenge. "Currently, low- and middle-income countries account for about 70% of cancer deaths" (Sloan F A. & Gelband Hellen, 2007).(2) In India, NCDs account for 60% of all deaths, with cancer accounting for 12% of these deaths (Example of Non-Communicable Disease, 2024). (3)

The incidence, pathology, and mortality of cancer exhibit geographic variations and these geographic variations in cancer are influenced by socio-cultural behaviours, genetics, environment, lifestyle, and historical context. (Kanavos, 2006) (4). India is the second-largest contributor to the cancer burden in Asia after China, with around 1.2 million cancer cases and 0.9 million deaths reported in 2019 (Pti, 2024). (5)

Asia, has the highest burden of cervical cancer with 58 percent incidence and deaths globally. India has the highest incidence (21%), followed by China (18%). CC is responsible for 40 percent of total deaths (23% in India, 17% in China) (D. Singh et al., 2023). (6) Along with the escalating incidence of CC in the developing world, India itself is experiencing a huge burden, it becomes important to understand its incidence and mortality trends.

1.2 Burden of Cervical Cancer in India

Although CC is the second most common cancer among females in India, it is the fourth most common cancer to be diagnosed and the fourth leading cause of cancer-related death among women, according to the Global Cancer Observatory Report of 2022 (Bray et al., 2024a). This presents a serious public health concern. (7,8) (Fig 1.3). Every eight minutes, a woman in India loses her life to CC, which makes up about 18% of all cancers in that country. (8) Furthermore, according to reports, India accounted for one in four of all women who died from cervical cancer worldwide (Correspondent, 2013). (9)

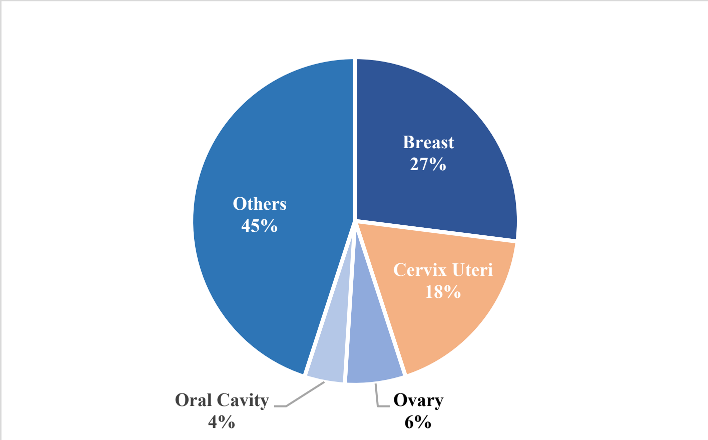


Fig 1.3 Top five most frequent cancers in Females (India)

Source: GLOBOCON cancer statistics 2022

India's National Cancer Control Program relies on cancer registries for crucial incidence data. (Mathur et al., 2020). (10) 2020 analysis of NCRP data revealed breast cancer as the most prevalent, and CC and cancer of ovaries also being commonly reported across PBCRs.

With CC presenting a significant public health challenge, concerted efforts from health and other sectors are required to address effectively (Takiar, 2018). (11) In 2020, India had the highest incidence and mortality rates for cervical cancer worldwide, surpassing China (Muthuramalingam & Muraleedharan, 2023). (12) In LMICs, delayed diagnosis due to inadequate screening and treatment accessibility has worsened the situation. Effective methods like HPV DNA testing, Pap smear, and VIA are available, but uptake remains low (1.9% in India, 0.2% in Gujarat). (13) In India, cervical cancer screening is hindered by societal taboos, resource scarcity (including lack of skilled staff, medical equipment, and lab services), and challenges unique to the local context. Consequently, the screening techniques typically employed successfully in developed nations might not be feasible in India's setting (Easing the Cervical Cancer Disease Burden in India | Think Global Health, 2023). (14)

1.3 Cervical Cancer Epidemiology

The risk for cervical cancer varies within a country's female population. In India, there is a demographic of over 511.4Mn women who are 15 years or older, all of whom are at potential risk for cervical cancer. (IARC,2023). (15)

1.3.1 Cause and Risk Factors

Human Papillomavirus (HPV), which is transmitted through sexual contact, is recognized as the primary cause of cervical cancer. ICMR has notified HPV types 16 and 18 to be accountable for ~70 percent of all cervical cancer cases globally. (Sreedevi et al., 2015). (16) Although HPV has been identified as the causative agent, it alone isn't sufficient and requires other contributing factors as covariates in the advancement of the condition (Jeronimo Jose et al., 2016). (17) Women with HIV have a sixfold increased risk of being diagnosed with CC than those who are HIV-negative (WHO 2020). American Cancer Society considers smoking, long term use of oral contraceptive, multiple full-term pregnancies, becoming sexually active at young age, poor menstrual hygiene and having family history of cancer contributing factors for cervical cancer.

In India, women face a cumulative 2.5 percent lifetime risk and a 1.4 percent cumulative death risk from cervical cancer (Kaarthigeyan, 2012). Alarmingly, it's estimated that 6.6 percent of women are believed to be infected with cervical HPV. Inadequate screening facilities and lack of access to affordable quality treatment in less developed countries, resulting in delayed diagnosis worsens the problem (J. Singh et al., 2018a). (18) Cervical cancer typically develops early in a woman's life, often during their most active and productive years, with peak incidence between the ages of 30 and 34, and again between 55 and 65 (WHO, 2023). Almost 80 percent of sexually active women will contract genital HPV by the time they reach 50 years old (Kaarthigeyan, 2012). (19)

1.3.2 Sign and Symptoms

Cervical cancer is often asymptomatic in initial stages, complicating early detection. Symptoms typically appear only after the cancer has progressed. When symptoms of cervical cancer do appear, they may include:

- Post-coital vaginal bleeding
- Post-menopausal vaginal bleeding
- Intermenstrual bleeding or menstrual periods that are heavier or last longer than usual

- Vaginal discharge that may be bloody, have a foul smell
- Pain in the pelvic region or discomfort during intercourse

1.3.3 Prevention

Prevention strategies are crucial because the disease is often not detected until it has progressed significantly. WHO states vaccination as the primary and screening as the secondary most effective preventive measures for cervical cancer.

1.3.3.1 Screening for Cervical Cancer

Screening and detection of cervical cancer utilize techniques such as Human Papilloma virus DNA testing, Pap smear cytology, and VIA. MoHFW has endorsed VIA for women between 30 to 65 years old, to be conducted every five years (Operational guidelines, 2016). (20) The guidelines suggest that screening for prevalent cancers should be incorporated into the comprehensive primary healthcare services and can take place at PHCs and certain designated SCs. Since its adoption in 2016, widespread implementation of guidelines remains nascent, resulting in delayed diagnosis until symptoms manifest.

The Global Strategy adopted by WHO aims to lower the annual incidence of CC cases fewer than 4 per 100,000 women. 90-70-90 target has been set to reach this goal by 2030 (Ghebreyesus & Jakab, n.d.):

90-70-90 target

- To vaccinate 90 percent of girls with the HPV vaccine by the time they reach age 15
- To screen 70 percent of women with a high-quality of tests by ages 35 & 45
- To treat 90 percent of women with cervical disease

By concentrating on raising HPV vaccination rates, improving cervical cancer screening systems, and guaranteeing that women in developing nations have access to treatment, WHO hopes to achieve this goal.

1.3.3.2 Vaccination for HPV

There are now vaccines against HPV strain 16 and 18, which show promise in lowering the prevalence of anogenital malignancies, including CC. For primary prevention, two US FDA approved vaccines Gardasil and Cervarix have already been present in India for a long time. Cervavac (21), is the first domestically produced quadrivalent HPV vaccine developed by the Serum Institute of India and also in low cost. Despite the shown safety, tolerability, and effectiveness, these HPV vaccines have shown in preventing CC due to HPV, they are still not included in the UIP. Although recommended by many public health specialists only Sikkim has adopted it for standard immunization regimen.

1.3.3.3 Prognosis

Depending on the size and spread of tumor, CC can be divided into 4 clinical stages (Bhatla et al., 2021). (22) In India, more than half (60 percent) of cervical cancer cases are discovered when they have already progressed to a locally advanced stage. When detected early, the five-year survival rate stands at 73.2 percent. However, for those diagnosed at a more advanced stage, the prognosis is grim, with a five-year survival rate of only 7.9 percent (Bray et al., 2024a).

1.4 Rise of AI and Digital Health in India

India is undergoing a transformative shift in healthcare delivery through the integration of digital technologies. Initiatives such as the Ayushman Bharat Digital Mission and the rapid growth of health technology startups have positioned the country at the forefront of digital health innovation. These developments offer unprecedented opportunities for leveraging AI to enhance diagnostic accuracy, expand reach, and streamline healthcare services. In particular, AI applications in diagnostics are emerging as high-impact tools in areas where traditional methods face limitations in scale, consistency, and speed.

Globally, the healthcare AI market is projected to exceed USD 100 Bn by 2030, with applications in pathology, radiology, and cytology leading this transformation. In India, Tier-1 cities are at the epicentre of this digital shift due to their robust healthcare infrastructure, high patient volumes, and early exposure to advanced medical technologies. This makes them ideal environments to explore the readiness and perspectives of clinicians toward adopting AI-enabled tools.

One such innovation is the Genius Digital Diagnostics System (DDS), an AI-driven cytology platform designed to enhance the sensitivity and specificity of cervical cancer screening. With its potential to reduce human error, expedite diagnosis, and increase patient confidence, the DDS represents a breakthrough in preventive women's healthcare. However, successful integration depends largely on the acceptance and advocacy of key stakeholders—particularly gynaecologists, who are often the first point of contact for reproductive health issues.

Rationale for Focusing on Tier-1 Cities and Gynaecologists

Tier-1 cities such as Mumbai, Delhi NCR, Hyderabad, Pune, and Ahmedabad offer a unique testing ground for digital health interventions. These urban centres host a dense network of private healthcare providers, high-tech infrastructure, and a relatively health-literate population. Gynaecologists practicing in these cities are more likely to encounter advanced diagnostic platforms and are critical stakeholders in influencing screening uptake and patient education.

By focusing on this cohort, the study aims to generate practical insights into clinical adoption dynamics, inform vendor strategies, and guide policy recommendations.

1.5 Research Gap

Research in the field of cervical cancer has predominantly focused on clinical aspects such as disease pathology, screening efficacy, and epidemiological trends. However, there is comparatively less attention on the behavioural and technological adoption factors, especially concerning newer tools like AI-driven digital cytology. While several global studies highlight the clinical accuracy of AI in diagnostic imaging and cytology, there is a scarcity of research investigating healthcare provider's readiness and perceptions regarding such technologies in the Indian context.

Specific to India, existing studies emphasize traditional screening methods such as Pap smears and HPV testing but do not adequately explore the integration of AI-enhanced tools in routine gynaecological practice. Despite tools available in the market, there is no comprehensive understanding of gynaecologist's attitudes, perceived barriers (like cost, trust, training), and willingness to adopt such innovations.

1.6 Aims

This study aims to fill this critical gap by examining the perspectives of gynaecologists in Tier-1 cities, thereby providing context-specific insights that can support the development of adoption strategies, training models, and health tech implementation policies.

1.7 Objectives

1. To assess the current awareness and understanding of AI-based digital cytology among practising gynaecologists
2. To identify perceived benefits, challenges, and ethical concerns related to the use of AI in cervical cancer screening

3. To explore the infrastructural and training needs required for successful integration of AI-driven digital cytology in urban healthcare settings
4. To provide policy and implementation recommendations for scaling AI-driven cervical cancer screening in urban India

Chapter 2: Review of Literature

Cervical cancer remains a leading cause of mortality among women in India, despite being preventable through regular screening and vaccination. The integration of AI into cytology and histopathology has emerged as a promising strategy to enhance the efficiency, accuracy, and reach of cervical cancer screening services. This literature review synthesizes findings from studies that explore the development, validation, implementation, and clinical perception of AI-driven digital cytology systems.

Sr. No	Title of the Study	Author (Year)	Study Location	Sampling Technique and Sample size	Key Findings
1.	Artificial intelligence-based image analysis in clinical testing: lessons from cervical cancer screening. (23)	Didem Egemen et al. (2024)	Global	Conceptual review N/A	• Equivocal cytology cases create labelling challenges. It is recommended to include an "indeterminate" category during model development to reduce ambiguity. • AI systems to prioritize reducing high-risk errors, especially false negatives that could lead to missed cancer diagnoses.
2.	Introducing artificial intelligence in cervical cancer screening in rural setting of Uganda and Bangladesh and India: experiences of implementation and lessons learned. (24)	Jogchum Beltman et al. (2024)	Uganda, Bangladesh, India	Field Implementation N/A	• AI tools in cervical cancer screening are most effective when they are built around clearly defined clinical objectives. • The study underscores the need for aligning AI outputs with real-world clinical risk to ensure meaningful patient management, particularly in low-resource settings.

3.	Artificial intelligence strengthens cervical cancer screening – present and future (25)	Tong Wu et al. (2024)	Multi-country	Observational study	• AI demonstrated superior sensitivity and specificity in detecting low-grade and high-grade cervical lesions compared to conventional methods. • The study concluded that AI, when used either as a standalone or in combination with traditional screening tools, offers the most efficient and accurate strategy for cervical cancer screening based on ROC curve analysis.
4.	Acceptability of artificial intelligence for cervical cancer screening in Dschang, Cameroon: a qualitative study on patient perspectives (26)	Malika Sachdeva et al. (2024)	Cameroon	Qualitative, focus groups	• Most participants found AI-based cervical screening acceptable, particularly when explained clearly and implemented by trusted health providers. • Women with higher education levels showed greater acceptance.
5.	Artificial intelligence enables precision diagnosis of cervical cytology grades and cervical cancer (27)	Jue Wang et al. (2024)	China	16,056 samples from multicentre trials	• The AICCS system achieved an area under the curve (AUC) of 0.947, with a sensitivity of 94.6%, specificity of 89.0%, and overall accuracy of 89.2% in prospective assessments. • In a randomized observational trial,

					cytopathologists assisted by AICCS demonstrated a 13.3% increase in sensitivity compared to unaided cytopathologists, along with improvements in specificity and accuracy.
6.	Assessment of Efficacy and Accuracy of Cervical Cytology Screening with Artificial Intelligence Assistive System (28)	Xinru Bai et al. (2024)	US	8,086 ThinPrep slides	• AICyte demonstrated a sensitivity of 97.89%, matching that of the traditional One-Time Pap Interpretation. • When operating independently at a 50% negative cutoff value, AICyte achieved a sensitivity of 99.30% and a specificity of 9.87%.
7.	Enhancing cervical cancer cytology screening via artificial intelligence innovation (29)	Yuki Kurita et al. (2024)	Japan	Pilot study, small-scale	• The AI system significantly reduced the initial screening time to approximately 10 seconds per case, enhancing overall workflow efficiency. • The AI effectively prioritized abnormal cytology cases using anomaly scores, helping ensure that higher-risk cases received timely attention.
8.	Role of artificial intelligence	Francesca Moro	Global	Systematic review	• AI applications in ultrasound have shown improved

	applied to ultrasound in gynaecology oncology: A systematic review (30)	et al. (2024)			accuracy in diagnosing gynecologic cancers, including cervical cancer. • The integration of AI in ultrasound imaging holds promise for the early detection of gynaecological cancers, potentially improving patient outcomes.
9.	Performance of a Full-Coverage Cervical Cancer Screening Program Using on an Artificial Intelligence- and Cloud-Based Diagnostic System: Observational Study of an Ultra large Population (31)	Lu Ji et al. (2024)	China	Ultra-large population with random sampling	• The implementation of the AI and cloud-based system significantly increased the coverage of cervical cancer screening, enabling access to a broader population, including those in remote and underserved areas. • The cloud-based infrastructure facilitated real-time data sharing and scalability, ensuring that the system could be effectively deployed across various healthcare settings and adapted to different population sizes.
10.	Artificial Intelligence-driven Digital Cytology-based Cervical Cancer Screening: Is the Time Ripe to Adopt This	Ruchika Gupta et al. (2023)	India (Tier-1 cities)	Qualitative, interviews	• 76% noted faster turnaround and greater patient trust; highlighted readiness in urban India despite infrastructure challenges. • AI algorithms have demonstrated improved sensitivity and specificity in

	Disruptive Technology in Resource-constrained Settings? (32)				cervical cancer screening compared to traditional methods, reducing subjectivity in cytological interpretations.
11.	Applying Artificial Intelligence to Gynaecologic Oncology: A Review (33)	David P. Mysona et al. (2021)	Global	Narrative review	• Machine learning models have been utilized to predict patient responses to treatments, aiding in personalized therapy planning and improving prognostic assessments. • The implementation of AI in pathology has led to more efficient analysis of histopathological slides, reducing the workload on pathologists and expediting diagnosis.

Chapter 3: Research Methodology

3.1 Key Research Questions:

Primary Research Question:

1. What is the level of awareness among gynaecologists in Tier-1 Indian cities regarding AI-driven digital cytology?
2. What is the market potential and willingness of adoption for AI-enabled cervical cancer screening in Tier-1 Cities?

Secondary Research Questions:

1. What are the barriers to adoption of AI-enabled cervical cancer screening among gynaecologists in India?
2. How do factors such as turnaround time (TAT), accuracy, and cost influence the decision-making process of healthcare professionals?
3. What factors influence the willingness of gynaecologists to partner with AI-based diagnostic platforms?

3.2 Research Design:

This study follows a descriptive cross-sectional design based on structured surveys and semi-structured interviews. This design is appropriate for capturing a snapshot of current practices, attitudes, and potential adoption behaviours of gynaecologists toward emerging digital screening technologies. The mixed-methods approach, combining quantitative surveys and qualitative open-ended responses, will allow for deeper insights and contextual understanding. The aim is to assess awareness, readiness, and perspectives of gynaecologists toward adopting AI-driven digital cytology systems for cervical cancer screening

3.3 Study Setting

The study was conducted in Tier-1 Indian cities, which had advanced healthcare infrastructure and are typically early adopters of digital innovations in medicine. These cities include:

- Mumbai
- Delhi NCR (including Gurgaon and Noida)
- Hyderabad
- Pune

- Ahmedabad

These cities were selected based on their high concentration of private gynaecological practices, exposure to digital health tools, and their role as early adopters of healthcare innovations in India.

3.4 Study Population

The target population comprises of practicing gynaecologists in private clinics, hospitals, fertility centres, and diagnostic centres. They are key influencers and decision-makers in cervical cancer screening practices.

Inclusion Criteria:

- Practicing gynaecologists in Tier-1 cities.
- Minimum 5 years of clinical experience.
- Actively engaged in cervical cancer screening.

Exclusion Criteria:

- Doctors not involved in cervical screening.
- Clinics without access to cytology infrastructure.
- Incomplete or non-consenting responses.

3.5 Research Procedure:

A non-probability purposive sampling method was employed, supplemented by snowball sampling to expand outreach. The study followed a systematic process for identifying, approaching, and interviewing practicing gynaecologists in Tier-1 Indian cities. The primary method of data collection was through online, semi-structured interviews.

1. Questionnaire and Interview Guide Development:
   A semi-structured interview guide was developed, consisting of both close-ended questions (to gather quantitative insights) and open-ended questions (to explore perceptions, barriers, and expectations related to AI-driven digital cytology). The interview schedule was reviewed by subject experts to ensure validity.

2. Recruitment of Participants:
   Participants were identified through purposive sampling, using directories, professional gynaecology associations (e.g., FOGSI), and networks in urban

clinical settings. Additional participants were recruited via snowball sampling based on referrals from initial respondents.

3. Scheduling and Consent
   Potential participants were contacted via email, WhatsApp, or LinkedIn. Once interest was expressed, a suitable time for the online interview was scheduled.

4. Interview Process

   - Interviews were conducted using Zoom, Google Meet, or phone calls, depending on the preference of the gynaecologist.
   - Each session lasted approximately 20 - 30 minutes.
   - With participants permission, interviews were audio recorded for transcription and analysis.
   - Interviewers took notes to capture key points and any non-verbal cues (where applicable).

5. Data Recording and Transcription
   Interviews transcribed verbatim for qualitative analysis. Close-ended responses were entered into a data sheet for statistical analysis.

6. Follow-ups and Clarification
   In cases where responses need clarification or further input, participants may be contacted again with their permission.

7. Data Security
   All data, including recordings and transcripts, were stored securely on a password-protected device or cloud system accessible only to the research team. Personally, identifying information were not retained.

8. Due to the limited timeframe for data collection (7 days), interviews were scheduled flexibly and prioritized based on respondent availability. This necessitated the use of purposive sampling to ensure inclusion of qualified, practicing gynaecologists while maintaining geographic diversity. Despite the time constraint, the sample was adequate for the exploratory nature of the research and allowed saturation of key themes to be achieved.

3.6 Sample Size:

The final sample compromised 61 gynaecologists practicing in Tier-1 Indian cities. This number was determined based on the feasibility of conducting qualitative interviews within a limited time frame of seven days. Given the short duration available for primary data collection, a purposive sampling approach was adopted to ensure inclusion of only those respondents who matched the study's criteria and were available for interview within the defined window.

While the sample size is modest, it reflects a diverse representation across cities such as Mumbai, Delhi NCR, Hyderabad, Pune, Ahmedabad, Gurgaon, and Noida, and includes clinicians with varied years of experience and practice types. The selected sample was sufficient to reach thematic saturation for the study's exploratory objectives and provided rich insights on the perceptions, readiness, and barriers to AI adoption in cervical cancer screening.

3.7 Sampling Technique:

A non-probability sampling strategy was followed:

- Purposive Sampling: To identify qualified gynaecologists meeting the inclusion criteria.
- Snowball Sampling: Existing respondents will recommend peers within their professional networks.

This approach ensured adequate diversity across geographies and practice types. The sample was limited to 61 participants due to a 7-day data collection window, which necessitated rapid recruitment through purposive and snowball techniques. This approach enabled the research to meet its objectives while acknowledging the practical constraints of the fieldwork timeline.

3.8 Study Instruments:

A structured questionnaire is the primary tool for data collection. It includes:

Section A: Demographics

- Name, City, Years of Practice, Type of Practice

Section B: Cervical screening practice

- Volume and frequency of screening
- Screening methods used (Pap, LBC, HPV)

Section C: AI awareness and adoption

- Familiarity with AI-based cytology
- Attitudes towards switching from conventional to AI tools
- Perceived barriers: cost, training, trust, patient receptiveness
- Factors influencing adoption: accuracy, turnaround time, regulatory approvals

Section D: Partnership willingness

- Openness to tie-ups with AI-enabled diagnostic companies
- Willingness to invest in premium screening
- Expectations from vendor (training, pricing, patient education)

Open-ended sections are included for qualitative comments.

3.9 Ethical Considerations:

- Voluntary Participation: Participants were informed that their involvement was completely voluntary.
- Anonymity and Confidentiality: No personal identifiers were collected. Data was analysed in aggregate form only.
- Right to Withdraw: Respondents had the right to discontinue participation at any time.

3.10 Limitations of the Methodology

- Due to the use of non-probability sampling, findings may not be generalizable to all gynaecologists in India.
- Self-reported data may be subject to social desirability and recall biases.
- Internet-based data collection may exclude non-tech-savvy participants or those in under-digitized clinics.

Chapter 4: Results

This chapter presents the findings from a qualitative and quantitative study conducted among 61 gynaecologists across Tier-1 Indian cities. The aim was to assess their awareness, attitudes, and readiness to adopt AI-driven digital cytology tools in cervical cancer screening, with a focus on Genius Digital Diagnostics System (DDS).

4.1 Demographic profile of respondents

Table 4.1 summarizes the frequency and percentage distribution of respondents across key variables, including years of experience, patient load, cervical cancer screening frequency, and screening methods employed.

Table 4.1: Demographic Profiles of the respondents [n = 61]

Category	Sub - group	Frequency	Percentage
Years of experience	> 15 years	41	67%
	6 – 15 years	19	31%
	< 5 years	1	2%
Patients seen weekly	>100	32	53%
	51 - 100	19	31%
	<50	10	16%
Screenings per week	>20	4	7%
	10 – 20	8	13%
	<10	49	80%
Screening Method used	Only PAP	1	2%
	Only LBC	41	67%
	Both	19	31%

Table 4.1 reflects a respondent group predominantly composed of highly experienced gynaecologists, lending credibility and depth to the study, as these practitioners are well-acquainted with existing screening protocols and clinical workflows. Despite managing a high weekly patient load, over half seeing more than 100 patients, the actual number of cervical screenings conducted remains relatively low, with 80% performing fewer than 10 screenings per week. This suggests a significant gap in preventive care

delivery that could be bridged by introducing more efficient and accessible screening technologies. The majority reliance on LBC, along with a considerable proportion employing both LBC and Pap smears, indicates a shift toward advanced diagnostic methods in Tier-1 urban settings. This transitional readiness, coupled with the operational pressures of busy practices, presents a strong case for integrating AI-driven cytology tools like the Genius Digital Diagnostics System, which offer the potential to streamline workflows, enhance diagnostic accuracy, and increase screening uptake.

4.1.1 Years of clinical experience

- 67% of the gynaecologists had over 15 years of clinical experience, indicating a majority of the sample comprises highly experienced professionals
- 31% had between 6 to 15 years, reflecting strong mid-career representation
- Only 2% had fewer than 5 years of experience, suggesting limited early-career input

4.1.2 Weekly patient load

- 53% of gynaecologists reported seeing more than 100 patients per week, indicating a very high patient throughput
- 31% handled 51–100 patients, while 16% saw fewer than 50 patients weekly

4.1.3 Number of Cervical Screenings conducted weekly

- A substantial 80% of respondents performed fewer than 10 screenings per week, while only 13% conducted between 10 - 20, and 7% reported screening more than 20 patients per week

4.1.4 Screening methods used

- A majority (67%) of gynaecologists reported using Liquid-Based Cytology (LBC) as their primary screening method
- 31% employed both LBC and Pap smears, suggesting a hybrid approach
- Only 2% relied exclusively on Pap smears

4.2 Willingness to adopt AI-based cytology tools

A central focus of the study was to assess gynaecologists readiness to adopt AI-enhanced digital cytology platforms.

Out of a total of 61 interviews conducted across seven tier - 1 cities, gynaecologists were categorized based on their responses into three groups:

- Readily interested in adopting the technology,
- Will need convincing, and
- Not interested (No).

Table 4.2: Willingness to adopt AI-based cytology tools

City	Interviews conducted	Readily interested	Will ned convincing	Not interested	Readily interested percentage
Mumbai	10	8	2	0	80%
Hyderabad	10	5	4	1	50%
Delhi	7	5	1	1	71%
Gurgaon	7	5	1	1	71%
Ahmedabad	10	6	3	1	60%
Pune	10	5	2	3	50%
Noida	7	5	1	1	71%
Total	61	39	14	8	
Percentage		64%	23%	13%	

Table 4.2 shows Mumbai exhibited the highest proportion of enthusiastic adopters, with 80% of gynaecologists readily interested. Delhi, Gurgaon, and Noida followed closely with 71% expressing immediate readiness. Ahmedabad reported a moderate readiness rate at 60%, while Hyderabad and Pune reflected lower adoption enthusiasm at 50%. Cities like Hyderabad and Pune also showed a relatively higher number of respondents needing further convincing or currently not interested.

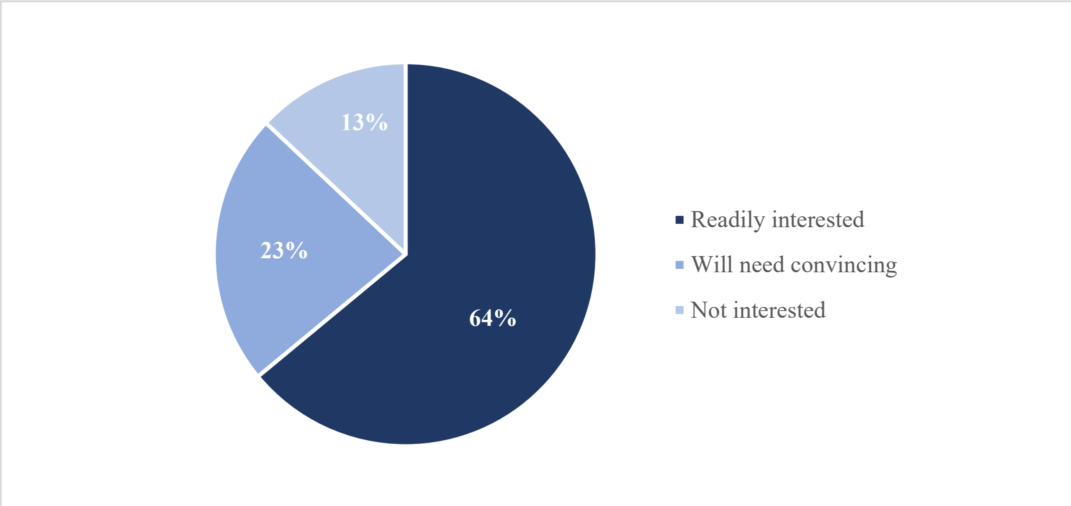


Fig 4.2.1 Willingness to adopt AI based Cytology tools

Fig 4.2.1 suggests a positive outlook toward AI-based screening, with nearly two-thirds (64%) of respondents expressing immediate readiness to integrate AI-driven digital cytology into their practice. However, the 23% of respondents will need convincing, and the 13% who remain hesitant, indicate that targeted educational initiatives, cost-benefit clarity, and clinical efficacy evidence are critical to accelerating adoption.

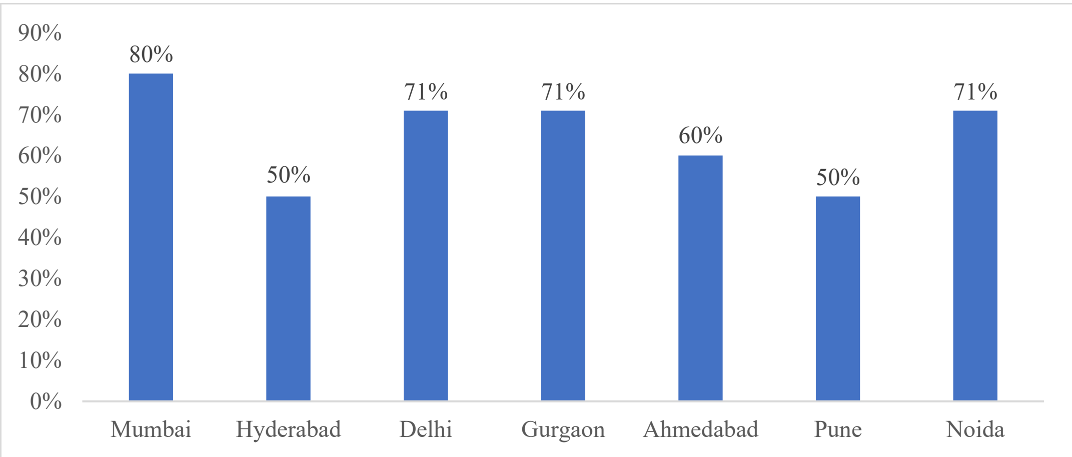


Fig 4.2.2 City-wise distribution of willingness to adopt AI based cytology tools

Fig 4.2.2 reflects a generally favourable environment for innovation in cervical cancer screening, particularly in cities like Mumbai, Delhi NCR, and Ahmedabad. Cities with higher reluctance, such as Hyderabad and Pune, may benefit from localized pilot programs, peer-led workshops, and exposure to success stories from early adopters in comparable settings.

These findings align with the study's objective of understanding gynaecologists perspectives and readiness across regional contexts, and they reinforce the need for strategic, city-specific implementation plans for AI integration in cervical cancer screening programs.

4.3 Perceived role in driving screening uptake

Gynaecologists believe they play an influential role in encouraging cervical cancer screening among their patients.

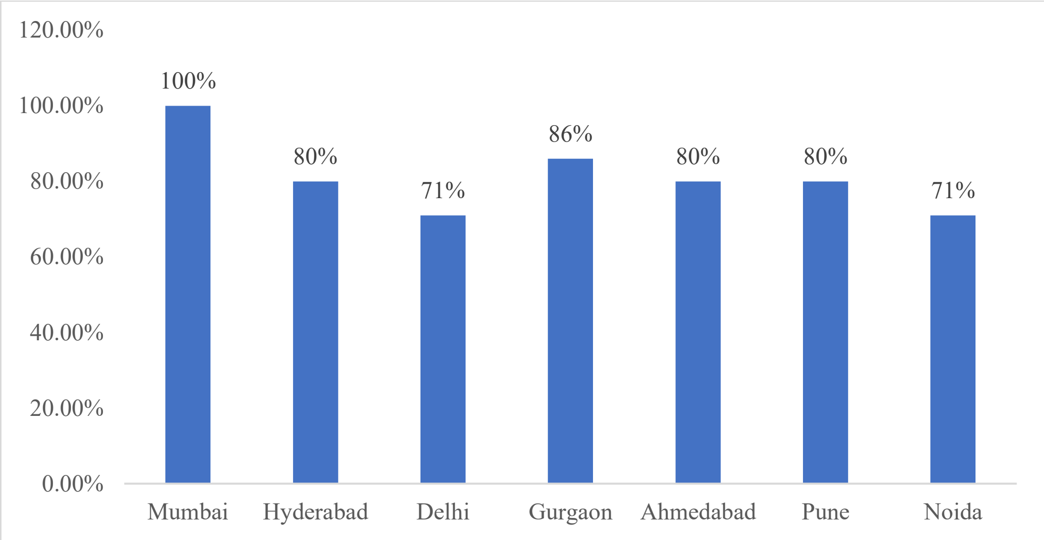


Fig. 4.3 Perceived role in driving screening uptake

Fig 4.3 shows that majority of gynaecologists across cities recognize their important role in promoting cervical cancer screening. This perception is strongest in Mumbai, suggesting that initiatives targeting gynaecologists as key change agents may be particularly effective in urban, high-volume centres. The relatively lower figures in Noida and Delhi highlight the need for supportive interventions, such as awareness campaigns or institutional incentives, to empower clinicians in these regions to take a more active advocacy role.

Mumbai-based respondents showed unanimous confidence (100%), highlighting a strong sense of responsibility and leadership in screening advocacy. In contrast, cities like Delhi and Noida showed slightly lower confidence levels (~71%), indicating some variability in perceived influence across regions.

4.4 Barriers to adoption

During the interviews, gynaecologists were asked to share their views on what prevents patients from undergoing cervical cancer screening. The responses revealed a multi-faceted set of barriers ranging from psychological and cultural to economic and logistical constraints.

Key barriers identified

1. Lack of awareness

This was the most frequently cited barrier. Many respondents mentioned that women are simply unaware of the need for screening, the availability of tests like Pap smear or LBC, or the potential risk of cervical cancer. Examples include:

- “Many women are not aware of the test and vaccination”
- “No access to healthcare and lack of awareness among most women”
- “Less awareness, high cost”

2. Cost and monetary constraints

A significant number of practitioners highlighted that financial barriers prevent patients from opting for screening.

- “Cost is a barrier, lack of awareness, and fear of cancer”
- “They don't want to spend money”
- “Monetary problem”

3. Fear and anxiety

Fear of the disease itself, as well as anxiety about the procedure, were recurrent themes.

- “Scare of cancer, thinks what will happen now”
- “Patient scared of speculum examination”
- “Fear of going to the doctor, shyness is there”

4. Discomfort and Embarrassment

Cultural discomfort, shyness, and hesitation around intimate medical examinations were often mentioned.

- “Shy, not vocal, not comfortable”
- “Being discomfort with the examination”
- “Not comfortable for check-up”

5. Stigma and social norms

Social stigma associated with cancer and sexual health continues to hinder screening participation.

- “Stigma regarding cancer”
- “Some women need consent from home as they are not the decision-makers”
- “Shyness, afraid”

6. Misconceptions and lack of medical education

Some patients believe screening is only needed if they have a family history or symptoms. Others fear surgical procedures due to misconceptions.

- “People think checking for cancer means some surgical procedure”
- “No history of cancer in the family, so they think they don’t need it”

7. Technical and logistical barriers

Some clinicians pointed to the perceived technical complexity of the procedure as a discouraging factor.

- “Because of technicality of collecting sample”
- “Technicality of the procedure”

These findings highlight that awareness alone is not enough; a layered strategy is required to address economic, emotional, educational, and cultural barriers. Interventions such as:

- Public health education campaigns
- Affordable or subsidized screening programs
- Use of less invasive AI-driven tools to minimize discomfort
- Involvement of community health workers to educate and build trust
  will be crucial to increasing screening uptake

Importantly, the integration of AI-based digital cytology tools, if properly communicated, could play a role in reducing anxiety around manual errors, increase trust in diagnosis, and possibly streamline the process, making it more acceptable to women hesitant due to procedural concerns.

4.5 Perceptions on pricing structure

Respondents were presented with the model of buying LBC tests at Rs. 2000 and offering them at Rs. 2500 to patients.

Table 4.5 Perceptions on Pricing Structure

City	Interviews conducted	Response		
		Yes	Yes (conditional)	No
Ahmedabad	10	8	1	1
Delhi	7	2	5	-
Gurgaon	7	5	1	1
Noida	7	4	2	1
Mumbai	10	6	2	2
Hyderabad	10	3	6	1
Pune	10	4	3	3
Total	61	32	20	9
Percentage	-	52%	33%	15%

A total of 61 interviews were conducted, with respondents answering whether they would be willing to adopt AI-based cytology platforms in their cervical cancer screening practices. Responses were categorized as "Yes", "Yes (conditional)", and "No".

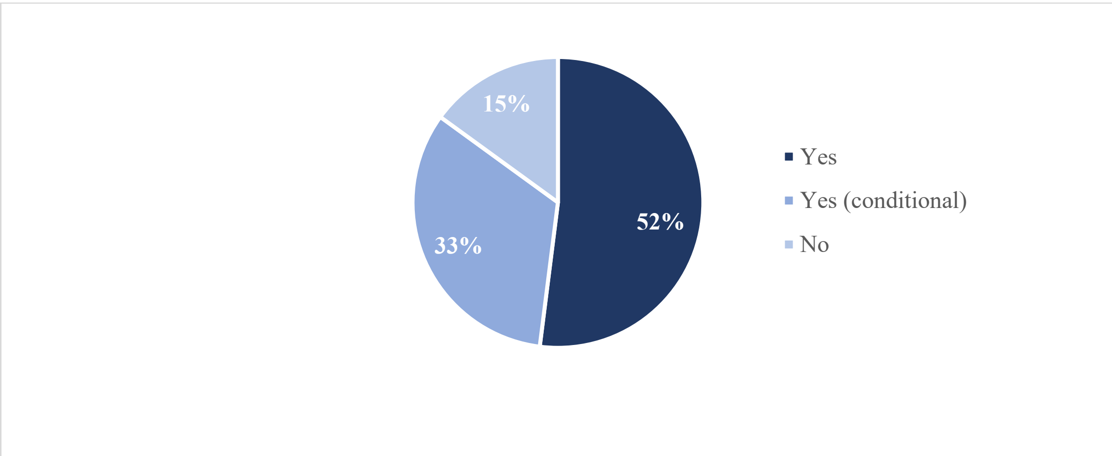


Fig 4.5.1 Perceptions of gynaecologists on adopting AI-based cytology at a proposed pricing model (n = 61).

Fig. 4.5 shows almost 52% of the gynaecologists interviewed were positively inclined to adopt the proposed pricing structure for AI-based cytology tools. These respondents found the pricing reasonable and aligned with the perceived value of improved diagnostic accuracy and faster turnaround times. Another 33% expressed conditional acceptance, contingent on factors such as patient affordability, institutional policies, and demonstrable clinical benefit. A smaller segment 15% rejected the model entirely citing concerns about insufficient ROI, patient reluctance to pay premium prices, or satisfaction with existing methods.

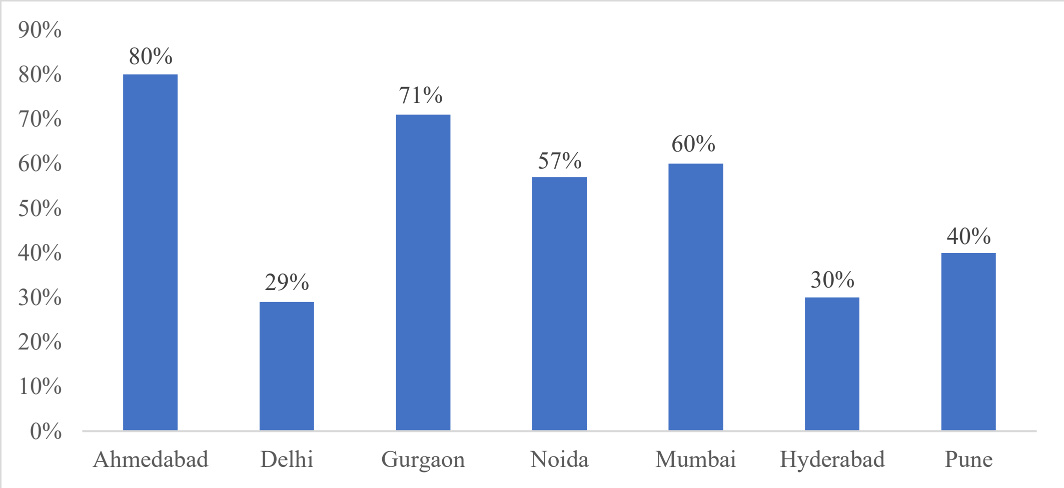


Fig 4.5.2 City-wise perceptions of gynaecologists on adopting AI-based cytology at a proposed pricing model (n = 61).

- Ahmedabad exhibited the highest positive response rate, with 80% of respondents expressing readiness to adopt AI-based screening tools as shown in Fig. 4.5.2
- Gurgaon followed with 71% reporting readiness
- Mumbai (60%), Noida (57%), and Pune (40%) demonstrated moderate willingness, while cities like Delhi (29%) and Hyderabad (30%) reflected a more cautious approach.

The cities with higher "Maybe" responses included Hyderabad (60%) and Delhi (71%), indicating a significant portion of gynaecologists who are open to adoption but require further assurance, such as evidence of efficacy, affordability, or institutional support.

4.6 Expectations from diagnostic partners

Respondents were asked what kind of support they would expect from an AI-based diagnostics provider:

1. Patient education materials

Mentions: ~45+

This was the most frequently mentioned category. Respondents emphasized the importance of clear and accessible patient education materials including pamphlets, flyers, brochures, and basic literature. Many highlighted this support as “most important” to enable better understanding and compliance among patients.

2. Videos for patients

Mentions: ~15+

Respondents expressed a strong preference for visual aids such as video presentations, Mp4-format videos, and short patient-friendly clips. These were often mentioned in conjunction with printed materials, indicating a need for multi-modal educational tools to effectively communicate with patients.

3. Operational assistance

Mentions: ~8–10

Several respondents requested support with logistics and operational processes. This includes assistance with sample collection, timely reporting, and other backend support to ensure seamless integration of AI diagnostics into clinical workflows.

4. Marketing support

Mentions: ~3–5

Marketing-related support such as promotional posters, banners, and digital content (e.g., WhatsApp videos) was mentioned by a few participants. These respondents tended to view the partnership as requiring shared responsibility in driving awareness and adoption.

5. Diagnostic tools / kits

Mentions: ~5–7

Some respondents highlighted the need for practical tools such as diagnostic kits, sample collection materials, and other related equipment. This indicates an expectation for providers to supply or facilitate access to essential testing tools.

6. Training

Mentions: ~3–4

Although not widely mentioned, a few respondents identified training needs, especially for pathologists and clinical staff. This suggests that educational support for healthcare providers is also an important component for successful implementation.

7. “Nothing” or “NA”

Mentions: ~4

A small number of respondents indicated they did not expect any additional support. These individuals may already have the necessary infrastructure or prefer to operate independently.

8. All-Inclusive Support

Mentions: ~6–8

Some participants expressed a desire for comprehensive support covering all of the above aspects like education, tools, training, and operations. Phrases like “all required” or “everything is needed initially” reflect this expectation.

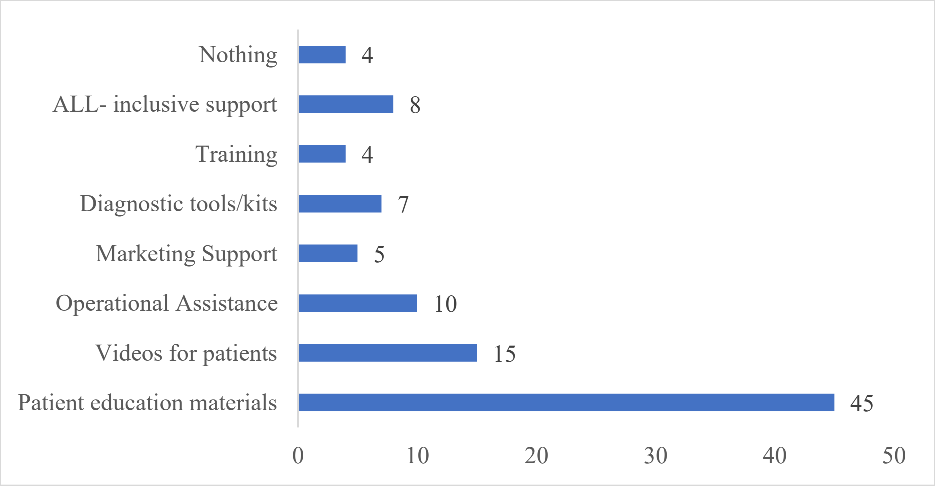


Fig 4.6 Type of support expected for successful partnership (Total<61 due to multiple responses)

Fig 4.6 suggests that patient education materials are the most requested support. Videos for patients and operational assistance are next in demand. Other categories like diagnostic tools, marketing, and training are also mentioned but less frequently. A few responses indicated all-inclusive support or no support needed.

4.7 Reasons for refusal

For the 13% of gynaecologists who expressed unwillingness to partner or adopt AI-based cytology, the main reasons were:

- High operational costs and unclear ROI
- Sufficient satisfaction with existing Pap smear/LBC results
- Distrust or discomfort with AI interpretation

- Institutional restrictions (e.g., hospital contracts)

These concerns were more prevalent among clinics already equipped with in-house pathology labs or those tied to government screening programs.

Chapter 5: Discussion

This chapter interprets the findings of the study exploring the adoption of AI-driven digital cytology for cervical cancer screening among gynaecologists in Tier-1 Indian cities. The results are analysed in light of existing literature and framed within the context of broader clinical and technological trends. This section also highlights the study's strengths and limitations.

The outcomes of the study show a largely favourable attitude toward incorporating AI-based cytology into cervical cancer screening practice among gynaecologists. Nearly 64% of respondents showed immediate readiness to adopt the technology, while another 23% were willing to consider it with greater assurance. Only 13% were not interested, mainly because of infrastructural limitations or advocacy of existing methods. The level of willingness (64%) to use AI-based screening methods among the respondents demonstrates readiness among urban practitioners to accept disruptive innovations. This agrees with **Tong Wu et al. (2024)**, who observed AI's possibility of performing better than conventional methods in sensitivity and specificity. The main drivers mentioned by gynaecologists included higher accuracy and quicker results as primary motivators are in line with global goals of detection of early cancer and lower rates of diagnostic errors.

These results indicate a promising environment for innovation, especially in urban areas like Mumbai and Delhi NCR, where adoption interest was the highest. Conversely, comparatively lower interest in cities like Hyderabad and Pune could reflect region-specific operating or institutional challenges, which need specially crafted intervention.

Despite recognition by 82% of gynaecologists of their critical role in encouraging screening, 80% conduct fewer than 10 cervical screenings per week. This gap indicates an implementation gap, which may be caused by patient resistance, cost considerations, or low institutional incentive. Even in technically advanced urban settings, behavioural momentum amongst patients and doctors seems to repress screening uptake.

This is in line with **Sachdeva et al. (2024),** who showed that patient engagement tools can have a strong impact on AI-based screening acceptance. The excess demand for patient education resources and explainer videos also further supports the requirement for patient-focused communication strategy to complement technological interventions.

The most frequently mentioned clinical motivators were:

- Increased diagnostic accuracy
- Decreased turnaround times
- Decrease in human interpretation errors
- Regulatory reassurance because of US FDA approval of platforms such as Genius DDS

These are based on research like "Artificial Intelligence Strengthens Cervical Cancer Screening" (2024), which showed how AI can identify high-grade lesions with greater sensitivity and specificity. According to J. Singh et al. (2023), AI-driven cytology systems might drastically cut the average slide reading time from 180 to 12 seconds without sacrificing diagnostic reliability. This finding reflects your respondents' desire for efficiency.
In addition, the realization of AI's potential to boost patient confidence was observed, further solidifying its value proposition for use in clinical practice.

Results align with international trends showing increased confidence in AI in diagnostics. For example, a multi-country study conducted in Uganda, Bangladesh, and India (2024) determined AI-based decision support systems to be acceptable and accurate in rural settings, also affirming your urban findings.

The 23% respondents were conditionally interested in adoption expressed concerns that echoed systemic barriers: uncertain ROI, patient affordability, and unfamiliarity with operations. These findings are significant when compared to LMIC studies (e.g., Beltman et al., 2024), highlighting the compatibility with current workflows, cost-effectiveness and ease of use are strong drivers of AI adoption.

Interestingly, 13% who simply rejected AI implementation were in institutions with established pathology infrastructure or inflexible administrative practice. Their use of conventional Pap and LBC techniques points to established routines and compliance with the status quo, supporting the findings of Mysona et al. (2021), who claimed that institutional inertia is a significant obstacle to healthcare innovation.

Notably, whereas research in LMICs is concerned with access and accuracy, this research concentrates on workflow efficiency, training expectations, and cost-

benefit clarity—concerns more common in urban, high-volume private practice.
Also, finding that patient educational materials were the most sought-after type of partnership assistance is consistent with previous research from Cameroon (2024), which observed that uptake of AI was heavily dependent on whether patients comprehended and viewed the technology as useful.

Strengths of the Study

1. **Context-specific insight**: Targeted Tier-1 Indian cities with high-volume practices and early exposure to digital tools.
2. **Mixed-methods approach**: Integrated quantitative measures with qualitative feedback for an overarched understanding.
3. **Relevance to policy and practice**: Findings can guide vendor strategies, institutional implementation platforms, and government policy on AI integration in diagnostics.

5.1 Limitations

Although the study yields useful insights into the adoption potential of AI-based digital cytology for cervical cancer screening, there are some limitations that need to be noted:

1. Sampling Bias: The research employed non-probability purposive and snowball sampling, which could constrain generalizability. The participants were mostly accessed through professional networks in Tier-1 cities, potentially excluding dissenting or less digitally exposed voices.

2. Geographical Limitation: The study was limited to Tier-1 cities, excluding insights from Tier-2, Tier-3, and rural India where infrastructural, economic, and digital adoption contexts can differ markedly.

3. Limited Sample Size: With only 61 gynaecologists interviewed, the sample, although sufficient for exploratory studies, might fail to capture the entire gamut of views in India's heterogenous healthcare environment.

4. Self-Reported Data: Data were obtained from self-administered questionnaires and interviews, which are prone to recall bias and social desirability
bias. Participants might have over- or under-reported their attitudes and practices.

5. Technology Exposure Variance:
A few participants lacked or had minimal direct exposure to AI-based cytology

platforms. Responses from them could be based on assumptions or perceptions instead of informed judgments following hands-on experience

6. Vendor-Specific Framing:

While the research remained objective, framing and examples (e.g., the Genius DDS system) could have subtly affected perceptions, particularly if responders were not famil iar with other platforms.

7. Short-Term Perspective: The research gives a snapshot of readiness and attitude at a specific time but does not follow through with actual behavioural change or take-up outcomes over the longer term.

5.2 Strengths

- The study targets Tier-1 Indian cities, where digital health adoption is most likely, offering realistic and practical insights into early adoption environments.
- Addresses the pressing public health challenge of cervical cancer and explores innovative AI-based diagnostic tools—a highly relevant area given the global shift towards tech-driven healthcare.
- Combines quantitative surveys with qualitative interviews, enabling both statistical analysis and deeper exploration of gynaecologists' perceptions, motivations, and concerns.
- Focuses on gynaecologists, the key influencers in cervical screening adoption, providing direct insights from decision-makers in clinical practice.
- 67% of respondents had over 15 years of clinical experience, enhancing the credibility and reliability of responses.
- The study employs purposive and snowball sampling, effectively reaching relevant and qualified participants in busy urban practices.

Chapter 6: Recommendations

To increase the prevention of cervical cancer and improve the health outcomes among the women certain recommendations on the basis of findings from the study can be implemented.

I. Policy-Level Recommendations

- **Incorporate AI into National Screening Programs:** The Ministry of Health and Family Welfare (MoHFW) should contemplate a role for an AI-based cytology platform within existing cervical screening programs in an effort to ensure greater coverage of screening and accuracy of diagnosis.
- **Subsidy and Reimbursement Policies:** Explore pricing subsidization or a public-private partnership model to alleviate the burden on patients and clinics, to facilitate the uptake of AI-based tools.
- **Regulatory Frameworks:** Formulate a national AI in health regulatory framework in relation to data privacy, validation of AI as a diagnostic tool, and ethical use of AI within a clinical environment.

II. Clinical Practice Recommendations

- **Training & Onboarding:** To foster trust in AI-assisted diagnoses and guarantee seamless operational integration, hold training sessions for lab personnel and physicians at the city level.
- **Peer-to-Peer Advocacy:** In order to establish credibility with reluctant peers and show success stories, encourage seasoned adopters to act as AI Ambassadors.
- **Workflow Integration**: Present modular AI solutions that reduce the learning curve and increase efficiency by integrating easily with current systems.

III. Vendor-Side Recommendations

- **Comprehensive Support Packages**: Diagnostic solution providers should offer bundled services, including:

    1. Patient education materials (leaflets, digital brochures)
    2. Visual aids (demo videos, explainer animations)
    3. Diagnostic kits and sample handling logistics
    4. Customer service helplines and clinician support

- **Flexible Pricing Models**: To attract new users, vendors should provide trial deployments, volume-based usage discounts, and tiered pricing models.
- **Evidence-Based Marketing**: To remove doubts and establish trust, present clinical data, white papers, and testimonies demonstrating better results with AI cytology.

IV. Patient-Centric Recommendations

- **Community Awareness Campaigns:** To inform women about the dangers of cervical cancer and the advantages of AI-enhanced screening, start focused awareness campaigns in urban areas.
- **Simplify Procedure Experience:** To lessen screening-related anxiety, discomfort, and stigma, use AI systems that provide rapid, minimally invasive, and trustworthy diagnosis.
- **Engage ASHAs and ANMs:** Instruct Auxiliary Nurse Midwives and Accredited Social Health Activists to serve as screening facilitators and community educators.

V. Future Research Recommendations

- **Expand Geographic Coverage:** To determine regional barriers and evaluate the national scalability of AI solutions, extend investigations to Tier-2 and rural cities.
- **Longitudinal Impact Assessment**: Evaluate AI-based cytology platforms over an extended period of time to gauge their cost-effectiveness, patient outcomes, and diagnostic accuracy.
- **Patient Experience Studies**: In order to comprehend acceptability, satisfaction, and desire to conduct AI-based screening, future study should incorporate patient viewpoints.

Chapter 7: Conclusion

This study examined the perspectives of gynaecologists in Tier-1 Indian cities regarding the adoption of AI-driven digital cytology tools for cervical cancer screening. With cervical cancer continuing to pose a major public health challenge in India—especially due to low screening uptake—there is an urgent need for innovative, efficient, and scalable diagnostic solutions.

- A significant majority of respondents (64%) indicated a high willingness to adopt AI-based cytology systems, 23% of respondents indicated conditional interest in adopting AI-based cytology systems. Only 13% reported reluctance to engage with these kinds of technologies.

- The main drivers of adoption were regulatory assurance (e.g., US FDA approval), reduced human error (65%), faster turnaround time (70%), and high diagnostic accuracy (76%).
- Adoption was hampered by institutional limitations, skepticism about AI, high operating expenses, and comfort with current screening techniques.
- Gynecologists stressed that the most important types of help from diagnostic firms are patient education materials, visual aids (videos), and operational assistance.
- The majority (82%) recognized their critical role in advancing cervical cancer screening, highlighting the significance of advocacy led by clinicians in encouraging uptake.
- Interestingly, even though the majority of practitioners encounter more than 100 patients each week, only 80% of them perform cervical screenings, suggesting that AI techniques may be used to scale and expedite screening efforts.

AI-powered cytology technologies have the potential to revolutionize cervical cancer screening in India by increasing its precision, speed, and scope. The shift from conventional to digital procedures necessitates coordinated assistance from the clinical, commercial, and policy domains, despite the high level of enthusiasm among gynecologists. AI has the potential to significantly lower the incidence of cervical cancer and improve women's preventative healthcare in India if it is used strategically.

Implications for Practice and Policy

The results show that there is a favourable climate for integrating AI in cervical screening, especially in urban private healthcare settings. However, a multifaceted strategy is needed for successful adoption:

- **Awareness and training** are crucial to overcoming hesitation and foster confidence in AI-based systems
- **Affordability and value communication** must be addressed to ensure pricing models are both sustainable for clinics and acceptable to patients
- **Strategic vendor assistance**, such as operational tools and educational materials, can help ensure a more seamless adoption

As India strives to meet WHO's 90-70-90 cervical cancer elimination targets, the study also supports the integration of AI technologies into national screening programs.

Reference

1. National Cancer Institute. Cancer Statistics [Internet]. National Cancer Institute. 2024. Available from: https://www.cancer.gov/about-cancer/understanding/statistics
2. Gelband H, Sloan FA, editors. Cancer control opportunities in low-and middle-income countries.
3. Example of non communicable disease [Internet]. Care Health Insurance. Available from: https://www.careinsurance.com/blog/health-insurance-articles/list-of-major-non-communicable-diseases-in-india
4. Kanavos P. The rising burden of cancer in the developing world. Annals of oncology. 2006 Jul 1;17:viii15-23.
5. PTI. India registered 9.3 lakh cancer deaths, second highest in Asia: LANCET study. The Hindu [Internet]. 2024 Jan 3; Available from: https://www.thehindu.com/news/national/india-registered-93-lakh-cancer-deaths-second-highest-in-asia-lancet-study/article67701510.ece
6. Singh D, Vignat J, Lorenzoni V, Eslahi M, Ginsburg O, Lauby-Secretan B, Arbyn M, Basu P, Bray F, Vaccarella S. Global estimates of incidence and mortality of cervical cancer in 2020: a baseline analysis of the WHO Global Cervical Cancer Elimination Initiative. The lancet global health. 2023 Feb 1;11(2):e197-206.
7. Bray F, Laversanne M, Sung H, Ferlay J, Siegel RL, Soerjomataram I, Jemal A. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA: a cancer journal for clinicians. 2024 May;74(3):229-63.
8. Statistics at a glance, 2022 Top 5 most frequent cancers Number of new cases [Internet]. Available from: https://gco.iarc.who.int/media/globocan/factsheets/populations/356-india-fact-sheet.pdf
9. HT Correspondent. “One woman dies of cervical cancer every 8 minutes in India” [Internet]. Hindustan Times. 2013 [cited 2025 May 22]. Available from: https://www.hindustantimes.com/punjab/one-woman-dies-of-cervical-cancer-every-8-minutes-in-india/story-cvIhbAFnWFPym1dN8uqfTK.html

10. Mathur P, Sathishkumar K, Chaturvedi M, Das P, Sudarshan KL, Santhappan S, et al. Cancer Statistics, 2020: Report From National Cancer Registry Programme, India. JCO Global Oncology. 2020 Sep;6(6):1063–75.
11. Ramnath Takiar. Status of Breast and Cervix Cancer in Selected Registries of India OPEN ACCESS. ResearchGate [Internet]. 2018 Dec 4 [cited 2025 May 22];2(1):1–5. Available from: https://www.researchgate.net/publication/329885411_Status_of_Breast_and_Cervix_Cancer_in_Selected_Registries_of_India_OPEN_ACCESS
12. Muthuramalingam MR, Muraleedharan VR. Patterns in the prevalence and wealth-based inequality of cervical cancer screening in India. BMC Women's Health. 2023 Jun 26;23(1):337.
13. NFHS-5 (2019-2021)
14. Easing the Cervical Cancer Disease Burden In India | Think Global Health [Internet]. Council on Foreign Relations. Available from: https://www.thinkglobalhealth.org/article/easing-cervical-cancer-disease-burden-india
15. IARC-HPV related cancers Factsheet 2023
16. Sreedevi A, Javed R, Dinesh A. Epidemiology of cervical cancer with special focus on India. International journal of women's health. 2015 Apr 16:405-14.
17. Jeronimo J, Castle PE, Temin S, Denny L, Gupta V, Kim JJ, Luciani S, Murokora D, Ngoma T, Qiao Y, Quinn M. Secondary prevention of cervical cancer: ASCO resource-stratified clinical practice guideline. Journal of global oncology. 2017 Oct;3(5):635-57.
18. Singh J, Roy B, Yadav A, Siddiqui S, Setia A, Ramesh R, Singh K. Cervical cancer awareness and HPV vaccine acceptability among females in Delhi: A cross-sectional study. Indian Journal of Cancer. 2018 Jul 1;55(3):233-7.
19. Kaarthigeyan K. Cervical cancer in India and HPV vaccination. Indian Journal of Medical and Paediatric Oncology. 2012 Jan;33(01):7-12.
20. MoHFW screening guidelines
21. Cervavac vaccine -CDSCO
22. Bhatla N, Singhal S, Dhamija E, Mathur S, Natarajan J, Maheshwari A. Implications of the revised cervical cancer FIGO staging system. Indian Journal of Medical Research. 2021 Aug 1;154(2):273-83.
23. Egemen D, Perkins RB, Cheung LC, Befano B, Rodriguez AC, Desai K, Lemay A, Ahmed SR, Antani S, Jeronimo J, Wentzensen N. Artificial intelligence–

based image analysis in clinical testing: lessons from cervical cancer screening. JNCI: Journal of the National Cancer Institute. 2024 Jan 1;116(1):26-33.
24. Beltman J, Koot J, Shyamala G, Premalata S, Dsane L, Namuga J, Kabukye J, Prasad K. 1208 Introducing artificial intelligence in cervical cancer screening in rural setting of Uganda and Bangladesh and India: experiences of implementation and lessons learned. International Journal of Gynecological Cancer. 2024 Mar 1;34:A131-2.
25. Wu T, Lucas E, Zhao F, Basu P, Qiao Y. Artificial intelligence strengthenes cervical cancer screening – present and future. Cancer Biology & Medicine. 2024 Sep 19;1–16.
26. Sachdeva M, Datchoua AM, Yakam VF, Kenfack B, Jonnalagedda-Cattin M, Thiran JP, Petignat P, Schmidt NC. Acceptability of artificial intelligence for cervical cancer screening in Dschang, Cameroon: a qualitative study on patient perspectives. Reproductive health. 2024 Jun 28;21(1):92.
27. Wang J, Yu Y, Tan Y, Wan H, Zheng N, He Z, Mao L, Ren W, Chen K, Lin Z, He G. Artificial intelligence enables precision diagnosis of cervical cytology grades and cervical cancer. Nature Communications. 2024 May 22;15(1):4369.
28. Bai X, Wei J, Starr D, Zhang X, Wu X, Guo Y, Liu Y, Ma X, Wei Y, Li C, Zilla ML. Assessment of efficacy and accuracy of cervical cytology screening with artificial intelligence assistive system. Modern Pathology. 2024 Jun 1;37(6):100486.
29. Kurita Y, Meguro S, Kosugi I, Enomoto Y, Kawasaki H, Kano T, Saitoh T, Shinmura K, Iwashita T. Enhancing cervical cancer cytology screening via artificial intelligence innovation. Scientific Reports. 2024 Aug 22;14(1):19535.
30. Moro F, Ciancia M, Zace D, Vagni M, Tran HE, Giudice MT, Zoccoli SG, Mascilini F, Ciccarone F, Boldrini L, D'Antonio F. Role of artificial intelligence applied to ultrasound in gynecology oncology: A systematic review. International journal of cancer. 2024 Nov 15;155(10):1832-45.
31. Ji L, Yao Y, Yu D, Chen W, Yin S, Fu Y, Tang S, Yao L. Performance of a Full-Coverage Cervical Cancer Screening Program Using on an Artificial Intelligence–and Cloud-Based Diagnostic System: Observational Study of an Ultralarge Population. Journal of Medical Internet Research. 2024 Nov 20;26:e51477.
32. Gupta R, Kumar N, Bansal S, Singh S, Sood N, Gupta S. Artificial Intelligence-driven Digital Cytology-based Cervical Cancer Screening: Is the Time Ripe to

Adopt This Disruptive Technology in Resource-constrained Settings? A Literature Review. 2023 Apr 7

33. Mysona DP, Kapp DS, Rohatgi A, Lee D, Mann AK, Tran P, Tran L, She JX, Chan JK. Applying artificial intelligence to gynecologic oncology: a review. Obstetrical & Gynecological Survey. 2021 May 1;76(5):292-301.

Annexures

Questionnaire for Primary data collection

Sr No.	Questions
	Ask at Reception
1.	What are the consulting fees for patients?
2.	How many years of experience does the doctor have?
3.	How long has the doctor been running this centre?
	Ask from Doctor
	Cervical Cancer Screening numbers
4.	Total number of patients seen per day / week / month
5.	What is the volume of cervical cancer screenings performed per week?
6.	What methods are used for cervical cancer screening?
7.	Reason for using this particular method for screening.
8.	What are the costs of these cervical cancer screening methods?
	Cervical cancer and PAP Smear
9.	How does doctor collect the sample for CC screening?
10.	How many PAP smears are performed per week?
11.	Does the doctor perform HPV co-testing as well along with PAP or only PAP?
12.	Primary reason for screening (from patient's perspective)?
13.	Major volume of patients for CC screening is from which age group?
14.	What is the doctor’s opinion on cervical cancer screening (adequate/not)?
15.	Are there any barriers or patient hindrances for cervical cancer screening?
16.	In general, how frequently does the doctor recommend CC screening (Once in ____ Years)
17.	What role do you think gynaecologists can play a role in increasing cervical cancer screening rates?
18.	According to them, what steps can be taken to increase enrolments for CC Screening?
19.	Would the doctor be interested in championing / advocating for CC Screening?

20.	Does the doctor think that being an active promoter of CC screening would benefit his profile and overall reputation?
	Advanced LBC Technique
21.	Is the doctor aware of advanced LBC techniques?
22.	Has the doctor used advanced LBC techniques?
23.	According to the doctor, what are the advantages and disadvantages of LBC compared to traditional PAP smear methods?
	Company
24.	If the doctor starts cervical screening regularly, how many PAP smears will he be able to do daily?
25.	Would you prefer to partner with a company that is a market leader in cervical cancer screening, which does US FDA-approved cervical screening using AI-based reporting for thin prep smears and US FDA approved mRNA-based HPV testing?
26.	How likely are you to move away from your preferred lab to a highly specialized cervical cancer screening centre?
27.	Would you be okay partnering under the company's terms and conditions and receiving electronic payments?
28.	How comfortable would you be adopting a pricing structure where you purchase cervical screening tests at Rs 2000 and offer them to your patients at Rs 2500?
29.	Do you think your patients will perceive the value of advanced cervical screening technology at this price point?
30.	What types of support (e.g., patient education materials, diagnostic tools, operational assistance) would you expect from the company to make this partnership successful?
31.	Key Reason if the doctor refuses for the partnership