

Cost-Effectiveness of Population Screening Strategies for Gastric Cancer in India: A Markov Model Calibrated to High- and Low-Incidence Districts

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Research Article

Keywords: gastric cancer, mass screening, cost-effectiveness analysis, Markov model, health technology assessment, India

Posted Date: September 30th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-11193183/v1>

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Additional Declarations: The authors declare no competing interests.

Abstract

Background.

Gastric cancer imposes a substantial but geographically uneven burden in India, with age-adjusted incidence differing roughly seven-fold between registries. India has no organised gastric cancer screening programme, and no economic evaluation has assessed whether screening would represent value for money at Indian incidence levels and Indian prices.

Methods.

We constructed an eight-state Markov cohort model (well; precancerous lesion; localised and advanced cancer, each undiagnosed and diagnosed; cancer death; other-cause death) with annual cycles, following a cohort of 100,000 adults from age 40 over a lifetime horizon from a health-system perspective, discounting costs and outcomes at 3% per annum. Four strategies were compared: no screening, *Helicobacter pylori* test-and-treat (5-yearly), serum pepsinogen (3-yearly), and universal upper gastrointestinal endoscopy (5-yearly). Natural-history transition probabilities were calibrated by least-squares to two empirical targets: an observed stage distribution at diagnosis of 39.6% localised, and registry age-adjusted incidence. Two district scenarios were calibrated separately, representing the extremes of the published Indian range. Costs were anchored to Central Government Health Scheme (CGHS) tariffs and Indian episode-of-care estimates. Incremental cost-effectiveness ratios (ICERs) were compared against an empirically derived Indian threshold of 1–1.52 times GDP per capita.

Results.

In the high-incidence district scenario, all screening strategies improved outcomes but at high cost. Universal endoscopy averted the most deaths (228 per 100,000; number needed to screen 439 per death averted) and produced the greatest stage shift (71.1% versus 39.6% localised at diagnosis), at an ICER of ₹456,927 per QALY versus no screening. *H. pylori* test-and-treat was the least costly effective option (ICER ₹396,832 per QALY). On full incremental analysis, serum pepsinogen was dominated in both scenarios. In the low-incidence district scenario, ICERs rose approximately seven-fold (*H. pylori* ₹2,922,758; endoscopy ₹3,249,010 per QALY). No strategy fell below 1.52 times GDP per capita in either scenario. Threshold analysis indicated that incidence would need to reach approximately 20 and 23 per 100,000 per year for *H. pylori* test-and-treat and endoscopy respectively to become cost-effective at 1 times GDP per capita – above every incidence rate reported by Indian population-based registries. In probabilistic sensitivity analysis (10,000 iterations), no screening was the optimal strategy in 93.9% of iterations at 1 times GDP per capita and 63.8% at 1.52 times in the high-incidence scenario, and in 100.0% of iterations at every threshold in the low-incidence scenario.

Conclusions.

Under the assumptions modelled, no population-wide gastric cancer screening strategy is cost-effective at contemporary Indian incidence levels and thresholds, even in the highest-incidence districts. The determining variable is not test performance but background incidence. These findings argue against universal screening and in favour of restricting any future programme to genuinely high-risk subpopulations, while prioritising the primary-data gaps — India-specific test accuracy, stage-stratified survival, and reimbursement-based episode costs — that currently limit confidence in any such evaluation.

Introduction

Gastric cancer remains among the leading causes of cancer death worldwide[15] and is one of the more lethal malignancies in the Indian setting, where a majority of patients present with advanced disease.[8, 16] Unlike breast, cervical and oral cancer, for which India has articulated population screening policy, gastric cancer is not included in any organised national screening programme.

Two features of the Indian epidemiological picture make the screening question genuinely open rather than settled. The first is extreme geographic heterogeneity: age-adjusted incidence among Indian population-based cancer registries (PBCRs) spans roughly seven-fold, from about 1.6 per 100,000 in Bhopal to about 11.1 per 100,000 in Chennai,[1] with additional high-incidence foci described in the north-eastern states and the Kashmir Valley.[2, 3] A single national policy is therefore unlikely to be appropriate everywhere. The second is the so-called Asian enigma: *Helicobacter pylori* prevalence in India is high — commonly reported between 60% and 85% in parts of the north-east — yet gastric cancer incidence is markedly lower than in Japan or Korea, where comparable infection prevalence coexists with far higher cancer rates.[4, 5] This dissociation means that progression parameters transported unmodified from East Asian cohorts would likely overstate the benefit achievable from *H. pylori*-directed strategies in India.

The international screening literature reflects this dependence on background risk. Endoscopic screening has been associated with substantial gastric cancer mortality reduction in high-incidence national programmes, but the same literature repeatedly cautions that endoscopic mass screening is unlikely to be efficient in low-incidence settings, favouring risk-stratified approaches instead.[6, 7] Whether India's highest-incidence districts are high enough to cross that efficiency threshold has not, to our knowledge, been formally evaluated.

We therefore constructed a state-transition model to compare candidate gastric cancer screening strategies in India, calibrated separately to the high- and low-incidence extremes of the published Indian registry range, and evaluated against a contemporary, empirically derived Indian cost-effectiveness threshold.

Methods

Model structure

We developed a deterministic Markov cohort model with eight mutually exclusive health states: well; precancerous lesion (collapsing chronic gastritis, atrophic gastritis, intestinal metaplasia and dysplasia); localised cancer, undiagnosed; localised cancer, diagnosed; advanced cancer, undiagnosed; advanced cancer, diagnosed; gastric cancer death; and other-cause death. The two absorbing death states were tracked separately so that disease-specific and competing mortality could be distinguished.

The structure follows the Correa cascade, in which chronic inflammation progresses stepwise to atrophy, metaplasia, dysplasia and ultimately invasive carcinoma, and is adapted from published state-transition models of gastric carcinogenesis.[12, 13] Separating undiagnosed from diagnosed cancer states at each stage is what allows screening to act mechanistically rather than by assumption: a screening test moves individuals from an undiagnosed to a diagnosed state earlier than symptomatic presentation would, and it is this stage shift, not any assumed change in treatment efficacy, that generates health gain in the model.

The cycle length was one year, appropriate to the multi-year natural history of gastric carcinogenesis. A hypothetical cohort of 100,000 individuals entered at age 40 and was followed to age 99 or death (60 cycles). A half-cycle correction was applied to quality-adjusted life year (QALY) and life-year accrual. Costs and outcomes were discounted at 3% per annum. The analysis took a health-system perspective; a societal perspective incorporating productivity loss and out-of-pocket expenditure was not undertaken and is noted as a limitation.

Screening strategies

Four strategies were compared:

- No screening (current practice): cancer is detected only on symptomatic presentation.
- H. pylori test-and-treat, 5-yearly: serological testing with eradication therapy for positives. This strategy acts by interception — reducing the probability of progression from the precancerous state to cancer — and not by detecting cancer directly; its cancer-detection probabilities therefore remain at the symptomatic baseline.
- Serum pepsinogen, 3-yearly: a low-cost blood-based triage test, with positives referred for confirmatory endoscopy.
- Universal upper gastrointestinal endoscopy, 5-yearly: direct visualisation, modelled with both an interception effect (endoscopic resection of precancerous lesions) and a detection effect.

For the two strategies with a direct detection effect, the annual probability of moving from an undiagnosed to a diagnosed cancer state was modelled as the complement of the probability that

neither symptomatic presentation nor screening detected the disease, that is $1 - (1 - p_{\text{symptomatic}}) \times (1 - \text{uptake} \times \text{sensitivity})$. Screening costs were applied only in cycles when a screening round actually occurred, using a modulo gate on the cycle counter, rather than annually.

Data sources and parameter hierarchy

Parameters were sourced according to an explicit three-tier hierarchy, with each input labelled by tier: (i) India-specific data where available; (ii) Asian-regional proxies; (iii) Western data only where no Asian source existed. This labelling is retained in the model workbook so that reviewers can see precisely which conclusions rest on transported evidence.

Screening costs were anchored to CGHS package rates, which represent payer reimbursement and are therefore consistent with the health-system perspective. The endoscopy unit cost of ₹2,200 combines the CGHS gastroscopy rate (₹1,984 at NABH-accredited facilities) with a partial allowance for biopsy where a lesion is found.[9] Treatment costs require an important caveat: the CGHS surgical procedure fee for partial or total gastrectomy for carcinoma is only ₹22,368–26,450,[9] but this is a procedure fee alone, excluding ward and intensive care stay, drugs and investigations, which CGHS reimburses separately. Using it as a total treatment cost would understate the true episode cost by an order of magnitude. We therefore used episode-of-care estimates of ₹275,000 for localised and ₹375,000 for advanced disease, derived from reported Indian treatment costs, and flag the substitution of market-derived episode costs for a line-item reimbursement build as a limitation.

Utilities were taken from the published cost-utility literature. Background all-cause mortality used age-banded rates and should be replaced with current Registrar General of India life tables in any applied use of the model.

Calibration

No published study reports annual transition probabilities for the Indian gastric carcinogenesis cascade directly; such parameters are not observable and are conventionally obtained by calibration. We held the structural shape of the cascade fixed and treated two parameters as free: the annual probability of progression from precancerous lesion to localised undiagnosed cancer, and the annual probability of symptomatic detection of localised disease. These were fitted jointly by least-squares to two empirical targets.

The first target was the stage distribution at diagnosis. A retrospective cohort of 275 gastric cancer patients at a tertiary centre in eastern India reported 8.7% stage I, 30.9% stage II, 32.0% stage III and 28.4% stage IV, giving 39.6% localised (stage I–II) and 60.4% advanced (stage III–IV) at presentation.[8] The second target was age-adjusted incidence from Indian PBCRs, taken at each end of the published range.[1]

Two parameter sets were fitted, one per district scenario. Calibration converged essentially exactly on the stage-distribution target in both scenarios and to within 2% on incidence. Notably, the fitted symptomatic-detection parameter was near-identical across scenarios (0.1427 versus 0.1427), while the progression parameter differed approximately seven-fold (0.001186 versus 0.000169) – mirroring the seven-fold registry incidence gap, and indicating that the two targets identify the two free parameters largely independently rather than trading off against one another.

Analysis

We report total discounted costs and QALYs, gastric cancer deaths, stage distribution at diagnosis, deaths averted, and number needed to screen per death averted. ICERs were computed both pairwise against no screening and by full incremental analysis with exclusion of dominated and extendedly dominated strategies. One-way sensitivity analyses varied each major parameter across a plausible range. Threshold analysis identified the incidence at which each strategy would become cost-effective.

ICERs were interpreted against an empirically derived Indian cost-effectiveness threshold. A recent study estimating willingness-to-pay per QALY in the Indian population found it to range from 1 to 1.52 times GDP per capita, proposed as the threshold for health technology assessment in India;^[10] India's earlier HTA guidance had used the WHO-CHOICE 1–3 times GDP per capita convention.^[10] We therefore report against 1×, 1.52× and 3× GDP per capita, assuming GDP per capita of ₹210,000 (per-capita net national income was ₹205,324 in 2024–25).^[11] We regard the 1–1.52× range as the decision-relevant benchmark and retain 3× only for comparability with older literature.

Probabilistic sensitivity analysis used second-order Monte Carlo simulation with 10,000 iterations. Beta distributions were fitted to probabilities and utilities and gamma distributions to costs, by method of moments around the base-case means, with standard errors set to reflect the degree of confidence in each source – wider for transported test-accuracy and interception parameters, narrower for utilities. All strategies shared the same parameter draw within each iteration (common random numbers), so comparisons remain paired. We report mean ICERs with 95% credible intervals, cost-effectiveness acceptability curves (CEACs), and the probability that each strategy is optimal at each threshold, defined by maximum net monetary benefit.

Results

Calibration performance

Table 1 reports the calibrated parameter sets and the resulting model outputs against targets.

Table 1
Calibrated natural-history parameters and calibration performance, by district scenario.

Scenario	Target ASR	p (pre→localised)	p (symptomatic detection)	Modelled % localised	Modelled ASR
High-incidence (Chennai)	11.1	0.00118561	0.14272261	39.6%	11.10
Low-incidence (Bhopal)	1.6	0.00016897	0.14269323	39.6%	1.60

ASR = age-adjusted incidence rate per 100,000 per year. Target % localised at diagnosis was 39.6% in both scenarios. Both parameter sets were fitted by least-squares to the same two targets.

High-incidence district scenario

In the high-incidence scenario, the unscreened cohort experienced 755 gastric cancer deaths per 100,000 over the lifetime horizon, with 39.6% of cancers diagnosed at a localised stage. All three screening strategies reduced mortality and increased cost (Table 2).

Table 2
Health and economic outcomes per 100,000 cohort, high-incidence district (ASR 11.1/100,000/year).

Strategy	Total cost (₹)	Total QALYs	GC deaths	% localised	Deaths averted	NNS/death
No screening	134,357,208	2,235,593	755	39.6%	—	—
H. pylori test-and-treat	566,869,572	2,236,683	577	39.6%	178	562
Serum pepsinogen	998,586,674	2,235,928	699	59.9%	56	1,795
Universal endoscopy	769,161,987	2,236,982	527	71.1%	228	439

GC = gastric cancer. NNS = number needed to screen per gastric cancer death averted. Costs and QALYs discounted at 3% per annum.

Universal endoscopy produced both the largest mortality reduction (228 deaths averted per 100,000) and the largest stage shift, raising the proportion diagnosed at a localised stage from 39.6% to 71.1%. H. pylori test-and-treat averted 178 deaths without altering stage distribution, consistent with its mechanism: it prevents cancers rather than finding them earlier. Serum pepsinogen performed poorly, averting only 56 deaths at the highest total cost of any strategy, a consequence of its low sensitivity (34.1%) combined with the cost of confirmatory endoscopy for positives.

Pairwise against no screening, ICERs were ₹396,832 per QALY for H. pylori test-and-treat, ₹456,927 for universal endoscopy, and ₹2,580,221 for serum pepsinogen. On full incremental analysis, serum pepsinogen was dominated; the efficient frontier comprised no screening, H. pylori test-and-treat (₹396,832 per QALY), and universal endoscopy (₹675,708 per QALY incremental to H. pylori test-and-treat).

Low-incidence district scenario

Recalibrating to an ASR of 1.6 per 100,000 reduced lifetime gastric cancer deaths in the unscreened cohort to 109 per 100,000. Because screening costs are incurred across the whole eligible population regardless of incidence while benefits accrue only among the far smaller number of true cases, ICERs rose approximately seven-fold (Table 3).

Table 3
Health and economic outcomes per 100,000 cohort, low-incidence district (ASR 1.6/100,000/year).

Strategy	Total cost (₹)	Total QALYs	GC deaths	% localised	Deaths averted	NNS/death
No screening	19,327,648	2,239,542	109	39.6%	—	—
H. pylori test-and-treat	479,620,478	2,239,699	83	39.6%	26	3,869
Serum pepsinogen	878,596,301	2,239,590	101	59.9%	8	12,374
Universal endoscopy	670,842,353	2,239,742	76	71.1%	33	3,028

Abbreviations as in Table 2.

ICERs versus no screening were ₹2,922,758 per QALY for H. pylori test-and-treat, ₹3,249,010 for universal endoscopy and ₹17,775,037 for serum pepsinogen. Serum pepsinogen was again dominated. The number needed to screen to avert one gastric cancer death rose from 439 to 3,028 for endoscopy, and from 562 to 3,869 for H. pylori test-and-treat.

Comparison against cost-effectiveness thresholds

Table 4 compares ICERs against the empirically derived Indian threshold range and the legacy WHO benchmark.

Table 4
ICERs versus no screening, compared against Indian cost-effectiveness thresholds.

Strategy	ICER, high-incidence (₹/QALY)	ICER, low-incidence (₹/QALY)	Below 1.52× GDP/capita?	Below 3× GDP/capita?
H. pylori test-and-treat	396,832	2,922,758	No (neither)	High only
Universal endoscopy	456,927	3,249,010	No (neither)	High only
Serum pepsinogen	2,580,221	17,775,037	No (neither)	No (neither)

Thresholds assume GDP per capita of ₹210,000: 1× = ₹210,000; 1.52× = ₹319,200; 3× = ₹630,000 per QALY. "High only" indicates the criterion is met in the high-incidence scenario alone.

No strategy fell below 1.52 times GDP per capita – the upper bound of the empirically estimated Indian willingness-to-pay range – in either scenario. Only under the more permissive legacy 3× benchmark, and only in the high-incidence district, did H. pylori test-and-treat and universal endoscopy appear acceptable.

Threshold analysis

We inverted the model to determine the incidence at which each strategy would become cost-effective (Table 5).

Table 5
Age-adjusted incidence (per 100,000/year) required for cost-effectiveness.

Strategy	At 1× GDP/capita	At 1.52× GDP/capita	At 3× GDP/capita
H. pylori test-and-treat	20	14	7
Universal endoscopy	23	16	8
Serum pepsinogen	154	96	47

For reference, the highest age-adjusted incidence reported among Indian PBCRs in the source used for calibration was 11.1 per 100,000 per year (Chennai).

At the decision-relevant 1–1.52× threshold, H. pylori test-and-treat would require an incidence of 14–20 per 100,000 and universal endoscopy 16–23 per 100,000. Both exceed the highest rate used in our calibration. Serum pepsinogen would require incidence of roughly 96–154 per 100,000, far above any rate reported anywhere in India and comparable to historical peaks in East Asia.

Sensitivity analysis

One-way sensitivity analysis on universal endoscopy versus no screening in the high-incidence scenario (base-case ICER ₹456,927 per QALY) identified screening interval as the single most influential parameter: lengthening it to ten years reduced the ICER to ₹247,769, while shortening it to two years raised it to ₹1,089,304. Endoscopy unit cost was next most influential (₹221,837 to ₹927,106 across a halving and doubling), followed by the interception effect (₹821,746 at 25% to ₹309,653 at 75%) and the discount rate (₹278,636 at 0% to ₹646,961 at 5%).

Test sensitivity was comparatively unimportant: varying endoscopic sensitivity from 0.70 to 0.99 moved the ICER only between ₹581,521 and ₹416,592. Utility values and treatment costs had modest influence, each shifting the ICER by less than ₹45,000. Critically, no single-parameter variation brought the ICER below 1.52 times GDP per capita except lengthening the screening interval to ten years, which by itself also reduced the mortality benefit.

Probabilistic sensitivity analysis

Across 10,000 Monte Carlo iterations, mean ICERs closely reproduced the deterministic estimates (for example ₹395,242 versus ₹396,832 per QALY for H. pylori test-and-treat in the high-incidence scenario), indicating no material non-linearity bias. Credible intervals were nonetheless wide, reflecting genuine uncertainty in transported parameters (Table 6).

Table 6

Probabilistic sensitivity analysis: mean ICERs, credible intervals, and probability of being the optimal strategy.

Strategy	Mean ICER (₹/QALY)	95% credible interval	P(opt) 1×	P(opt) 1.52×	P(opt) 3×
High-incidence district					
No screening	Reference	—	93.9%	63.8%	2.4%
H. pylori test-and-treat	395,242	188,809 to 992,365	3.4%	21.7%	48.9%
Universal endoscopy	457,195	197,007 to 1,013,082	2.7%	14.5%	48.7%
Serum pepsinogen	2,566,298	1,219,144 to 6,704,780	0.0%	0.0%	0.0%
Low-incidence district					
No screening	Reference	—	100.0%	100.0%	100.0%
H. pylori test-and-treat	2,928,719	1,494,450 to 7,082,963	0.0%	0.0%	0.0%
Universal endoscopy	3,236,374	1,453,182 to 7,036,678	0.0%	0.0%	0.0%
Serum pepsinogen	17,619,458	8,362,047 to 46,582,141	0.0%	0.0%	0.0%

P(opt) = probability the strategy has the highest net monetary benefit at the stated multiple of GDP per capita (₹210,000). Multiples: 1× = ₹210,000; 1.52× = ₹319,200; 3× = ₹630,000 per QALY. 10,000 iterations.

In the high-incidence district, no screening was the optimal strategy in 93.9% of iterations at 1 times GDP per capita and remained most likely optimal (63.8%) at 1.52 times. Its probability of being optimal fell below 50% only above approximately ₹350,000 per QALY, and H. pylori test-and-treat did not become the single most likely optimal strategy until roughly ₹400,000 per QALY, with universal endoscopy overtaking it above about ₹700,000 per QALY. In the low-incidence district, no screening was optimal in 100.0% of iterations at every threshold considered, and did not fall below 50% until approximately ₹2,500,000 per QALY.

Serum pepsinogen had a 0.0% probability of being optimal at any threshold in either scenario, confirming its dominance in the deterministic analysis is robust to parameter uncertainty rather than an artefact of point estimates.

The probabilistic analysis therefore reinforces rather than qualifies the deterministic finding. Although individual credible intervals are wide, the joint uncertainty does not open a plausible pathway to cost-

effectiveness at Indian thresholds: even at the upper bound of the empirically estimated willingness-to-pay range, and even in the highest-incidence district modelled, the probability that any screening strategy is optimal remains below 25%.

Discussion

This analysis suggests that no population-wide gastric cancer screening strategy is cost-effective at contemporary Indian incidence levels when judged against an empirically derived Indian willingness-to-pay threshold — and that this conclusion holds even in the country's highest-incidence districts. The finding is driven not by poor test performance but by background disease frequency.

The mechanism is transparent in the results. Screening costs scale with the size of the eligible population; benefits scale with the number of true cases. When incidence falls seven-fold between Chennai and Bhopal, the cost side of the ratio barely moves while the benefit side collapses, and ICERs rise correspondingly. The threshold analysis makes the same point prospectively: the incidence required for endoscopic screening to become cost-effective at 1–1.52 times GDP per capita, 16–23 per 100,000, exceeds the highest Indian registry rate used here by roughly two-fold. This is quantitatively consistent with the international literature's caution that endoscopic mass screening is inefficient outside high-incidence settings, and it locates India — including its high-incidence districts — on the wrong side of that line.

Two secondary findings merit attention. First, serum pepsinogen was dominated in both scenarios. Its low sensitivity means few cancers are found, while its imperfect specificity generates confirmatory endoscopies among the much larger test-negative-for-disease population; the result is a strategy that costs more than universal endoscopy while averting a quarter as many deaths. A triage test only saves money if the triage is efficient, and at 34.1% sensitivity it is not. Second, *H. pylori* test-and-treat achieved most of endoscopy's mortality benefit at lower cost despite producing no stage shift whatsoever, because it prevents cancers rather than detecting them earlier. This distinction is easily obscured when strategies are compared on stage distribution alone, and it suggests that primary prevention deserves separate consideration from screening in the Indian policy conversation.

Implications for policy

These results argue against introducing universal gastric cancer screening in India on cost-effectiveness grounds, and against serum pepsinogen in any configuration modelled here. They do not, however, argue against all targeted activity. The threshold analysis identifies the incidence at which the calculus changes, which converts the policy question into an empirical one: are there identifiable Indian subpopulations whose incidence approaches 15–25 per 100,000? Certain north-eastern districts and the Kashmir Valley have been reported to carry substantially elevated rates,^[2, 3] and risk-stratified approaches — combining geography with *H. pylori* status, family history and age — could in principle concentrate screening on a population where the ratio is favourable even though the national or district-

wide average is not. Evaluating such stratified strategies was beyond the scope of this analysis and is the most policy-relevant extension of it.

Limitations

Several limitations qualify these findings and, in our judgement, matter more than the point estimates.

- Test accuracy is not India-validated. Serum pepsinogen sensitivity and specificity were taken from a prospectively validated United States study;^[12] H. pylori serology performance and endoscopic accuracy are illustrative. No Indian validation study was identified. Because pepsinogen's poor showing follows directly from its assumed sensitivity, an Indian validation study reporting materially different performance could change that specific conclusion, though sensitivity analysis suggests it would not change the overall finding for endoscopy.
- Stage-stratified survival is not India-specific. Annual case-fatality hazards were derived from assumed five-year survival by stage rather than from an Indian population-based stage-stratified survival curve, which we were unable to identify. Given documented later presentation and resource constraints, true Indian survival may be worse than modelled, which would increase the absolute benefit of stage shift.
- Costs mix reimbursement tariffs and market estimates. Screening costs use CGHS rates, but treatment episode costs are market-derived because CGHS procedure fees exclude ward stay, drugs and investigations. A line-item build from CGHS or PM-JAY components would be more defensible and is the single most tractable improvement available.
- Natural-history parameters are calibrated, not observed. Two free parameters were fitted to two targets, so the fit is exact by construction and does not itself validate the model. The stage-distribution target derives from a single tertiary-centre cohort of 275 patients, which is subject to referral bias and may not represent district-level presentation.
- Structural simplifications. Precancerous sub-stages were collapsed into one state; there is no explicit remission-and-recurrence structure; screening alters the stage at detection but not treatment efficacy conditional on stage; and adverse events, complications and false-positive harms were not modelled. Uptake was held constant rather than declining over successive rounds.
- Distributional assumptions and perspective. Probabilistic analysis requires assumed distributions and standard errors; because several parameters lack Indian primary data, the standard errors we assigned are themselves judgements rather than estimates, and correlations between parameters were not modelled. The perspective is health-system rather than societal — a material omission in a setting with high out-of-pocket expenditure, where catastrophic health expenditure is itself a policy outcome.

Given these limitations, the appropriate reading is directional rather than precise: the gap between the modelled ICERs and the Indian threshold is large — roughly an order of magnitude in the low-incidence scenario — and larger than plausible parameter revision would close. The conclusion is robust in sign even where it is uncertain in magnitude.

Conclusion

Population-wide gastric cancer screening does not appear to represent value for money in India at current incidence levels, whether by endoscopy, serum pepsinogen or H. pylori test-and-treat, and this holds in the highest-incidence districts as well as the lowest. Background incidence, rather than test performance, is the binding constraint, and probabilistic analysis indicates this conclusion is robust to parameter uncertainty. Future work should evaluate risk-stratified strategies in genuinely high-risk subpopulations and should prioritise the three primary-data gaps — India-validated test accuracy, India-specific stage-stratified survival, and reimbursement-based episode costs — that presently limit confidence in any economic evaluation of gastric cancer screening in India.

Declarations

Conflicts of interest:

No conflict of interest

Ethics approval:

Not required; this analysis used only published aggregate data and involved no human participants.

Data and model availability

The full model is implemented as a formula-driven Excel workbook with all parameters, sources and calibration logic exposed, and is available from the corresponding author / as a supplementary file.

Funding:

No funding

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