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Breast Cancer Burden in Transition: A GBD 2023 Forecasting Analysis of Global Trajectories and Health System Implications for Southeast Asia, East Asia, and Oceania, 2024–2050

Dr. Majie Diwa, Leah Quinto, PhD and R. George Atento, PhD

Abstract

Breast cancer is the most frequently diagnosed malignancy among females globally, and its projected burden through 2050 presents one of the most analytically consequential health system planning challenges of the coming decades. This paper presents a structured secondary data analysis of the Global Burden of Disease Study 2023 Breast Cancer Forecasts released by the Institute for Health Metrics and Evaluation in March 2026, covering projected female breast cancer incidence and mortality across eight global super-regions from 2024 to 2050. The analysis applies descriptive regional profiling, absolute burden trajectory analysis, age-standardized rate trajectory analysis, death-to-incidence ratio computation, and convergence-divergence assessment to characterize the global forecast landscape and position the burden trajectory of Southeast Asia, East Asia, and Oceania within it. Globally, breast cancer incidence is projected to rise 52.1% — from approximately 2.34 million to 3.56 million annual cases — while deaths rise 74.7% from approximately 782,000 to 1.37 million between 2024 and 2050. Southeast Asia, East Asia, and Oceania, which carries the second largest absolute regional breast cancer burden globally, is projected to record an additional 241,000 annual cases and 98,000 annual deaths by 2050. The region's age-standardized incidence rate is rising from 35.6 to 40.9 per 100,000 females while the global average remains flat, indicating genuine epidemiological transition beyond demographic effects. Its death-to-incidence ratio is simultaneously rising from 29.6% to 33.1%, moving toward the current global average rather than converging on the high-income country benchmark of 24.6%, signaling that aggregate health system performance is not improving commensurately with the epidemiological transition underway. Integrated with a thematic literature review spanning oncology infrastructure gaps, early detection evidence, digital health applications, and governance frameworks, the analysis identifies early detection infrastructure investment, universal health coverage financing, locally adapted AI diagnostic tools, and analytically informed workforce planning as the critical levers for intercepting the projected mortality trajectory in the region's lower-income sub-populations. The paper contributes forecast-anchored, decision-relevant health system planning intelligence for oncology administrators, health policymakers, and applied health analytics researchers serving the Asia-Pacific region.

Keywords: *breast cancer forecasting; GBD 2023; Southeast Asia East Asia and Oceania; health system preparedness; death-to-incidence ratio; early detection; oncology health system planning; Asia-Pacific cancer burden; universal health coverage; AI-assisted mammography*

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1. Introduction

Breast cancer, the most commonly diagnosed cancer among females worldwide, and the second most common frequently diagnosed cancer overall, continues to be one of the most consequential challenges confronting health systems in the twenty-first century (International Agency for Research on Cancer [IARC], 2025). It is a disease whose burden is not merely clinical but organizational, financial, and political — demanding sustained investments in screening infrastructure, diagnostic capacity, multi-disciplinary oncology workforce, treatment facilities, and palliative care systems that few low- and middle-income health environments have yet to secure at scale. For decades, the epidemiological literature has documented rising global incidence alongside declining mortality in high-income settings, a divergence that reflects the differential reach of early detection, timely treatment, and coordinated cancer governance. What has received less attention, however, is the projected future disease burden trajectories and its implications on the health systems that are still developing the institutional infrastructure to respond to it effectively.

The release in March 2026 of the Global Burden of Disease (GBD) Study 2023 Breast Cancer Forecasts by the Institute for Health Metrics and Evaluation (IHME) provides the most current and methodologically rigorous set of globally comparable projections available for this disease. Drawing on GBD 2021 forecasted values intercept-shifted to GBD 2023 baseline results, the dataset projects breast cancer incidence and mortality across global super-regions from 2024 through 2050, with 95% uncertainty intervals that allow for honest assessment of forecast confidence (Global Burden of Disease Collaborative Network, 2026). The accompanying analysis, published simultaneously in The Lancet Oncology, documents global, regional, and national burden trends from 1990 to 2023 with forward projections to 2050, offering the research and policy community a foundational resource for evidence-based planning at an unprecedented temporal horizon.

The aggregate global picture embedded in these forecasts is sobering. In 2024, approximately 2.34 million new breast cancer cases were recorded among females globally, with an estimated 782,000 deaths. By 2050, the central projection indicates that annual incidence will rise to approximately 3.56 million cases — a 52% increase — while deaths are projected to reach 1.37 million, representing a 75% increase over the same period (Global Burden of Disease Collaborative Network, 2026). These are not marginal increments. They represent a structural escalation in global oncological demand that will require commensurate expansion in health system capacity across nearly every region of the world.

Yet the global aggregate conceals analytically critical regional heterogeneity. High-income countries, which currently account for the highest age-standardized incidence rates at approximately 82.3 cases per 100,000 females, are projected to experience relatively modest absolute growth of approximately 17% through 2050 — a trajectory supported by decades of investment in mammographic screening, genomic diagnostics, and multi-disciplinary oncology care. Sub-Saharan Africa, by contrast, faces a projected 200% increase in cases, compounded by death-to-incidence ratios exceeding 51%, signaling severe structural deficits in detection and treatment access. South Asia confronts a projected doubling of its case burden by 2050. These divergent regional trajectories are not merely epidemiological observations — they are decision signals that carry direct implications for how health systems in different regions must prioritize, invest, and organize.

Within this global landscape, the super-region comprising Southeast Asia, East Asia, and Oceania occupies a position of particular analytical significance. In 2024, this region accounts for an estimated 548,000 new breast cancer cases — approximately 23% of the global total and the second largest absolute regional burden after high-income countries. Its age-standardized incidence rate of 35.6 per 100,000 is currently below the global average of 49.3, but it is rising — projected to reach 40.9 per 100,000 by 2050 — at a time when the global rate remains essentially flat. The region's death-to-incidence ratio of approximately 29.6% in 2024, while lower than the most constrained regions, remains substantially higher than the 24.6% recorded in high-income settings, indicating meaningful gaps in the effectiveness of detection-to-treatment pathways. By 2050, the region is projected to record approximately 789,000 new cases and 261,000 deaths annually — an absolute increase of over 240,000 cases representing a 44% rise from the 2024 baseline.

These patterns carry profound implications for health system preparedness in a region that is itself highly heterogeneous. Southeast Asia, East Asia, and Oceania encompasses economies at vastly different stages of health system development — from the well-resourced oncology infrastructures of Japan, Australia, and South Korea, to the considerably more constrained systems of Myanmar, Cambodia, Laos, and Pacific island nations. Within this diversity, a shared challenge is emerging: rising breast cancer burden that is potentially outpacing the expansion of detection, diagnostic, and treatment capacity in many national contexts. The analytical question is therefore not simply whether incidence will rise — the forecasts make clear that it will — but what the magnitude and trajectory of that rise demands of health system planners, policymakers, oncology workforce developers, and health financing architects across the region.

This paper addresses that question through a structured secondary data analysis of the GBD 2023 Breast Cancer Forecasts for the period 2024 to 2050. Using the IHME dataset as its primary analytical source, the paper pursues four objectives. First, it describes and compares projected breast cancer incidence and mortality trends across all global super-regions from 2024 to 2050, establishing a comparative analytical baseline. Second, it characterizes the specific burden trajectory of Southeast Asia, East Asia, and Oceania — in terms of absolute case counts, age-standardized rates, death-to-incidence ratios, and rate of change — relative to the global average and other super-regions. Third, it identifies the analytical signals in the forecast data that carry potential implications for oncology health system capacity, early detection infrastructure, workforce planning, and policy in the region. Fourth, it derives evidence-based recommendations for health system preparedness and resource planning in Southeast Asia, East Asia, and Oceania in response to the projected burden through 2050. In pursuing these objectives, the paper contributes to the growing body of applied health analytics scholarship that seeks to convert epidemiological forecasting data into actionable decision intelligence for health system managers, oncology administrators, and public health policymakers.

2. Review of Related Literature

2.1 Global Epidemiological Trends and Burden Forecasting of Breast Cancer

Breast cancer is the most frequently diagnosed malignancy among females globally, and accounts for a substantial and growing share of the total global cancer burden (IARC, 2025). The epidemiological trajectory of the disease over recent decades reflects a complex interplay of demographic expansion, changing reproductive and lifestyle risk factor profiles, and the differential penetration of organized screening programs across income settings. In high-income countries, age-standardized incidence rates rose sharply through the late twentieth century, partly as an artifact of mammographic screening detecting previously subclinical disease, and have since stabilized or plateaued in several national contexts. In low- and middle-income regions, incidence rates have continued to rise, driven by urbanization, shifts in fertility patterns, increased body mass index, and the adoption of Western dietary and reproductive behaviors — without the compensating mortality reductions that organized early detection has produced in wealthier settings.

The Global Burden of Disease study series, coordinated by the Institute for Health Metrics and Evaluation, has produced the most methodologically comprehensive and internationally comparable estimates of breast cancer burden available. Successive GBD iterations have documented not only the absolute scale of the disease but its distribution across age groups, regions, and national income levels, enabling comparative analysis that transcends the limitations of individual national registries. The GBD 2023 Breast Cancer Forecasts, released in March 2026, represent the most current available projection of this burden through 2050, using GBD 2021 forecasting models intercept-shifted to GBD 2023 baseline estimates to produce regionally disaggregated projections with 95% uncertainty intervals (Global Burden of Disease Collaborative Network, 2026).

The forecast data reveal a global breast cancer burden that is structurally escalating in absolute terms while remaining relatively stable in age-standardized rates — a pattern that reflects the dominant role of population growth and aging rather than underlying risk factor change in driving future case counts. Globally, the age-standardized incidence rate is projected to remain near 49 cases per 100,000 females between 2024 and 2050, while absolute case numbers rise from approximately 2.34 million to 3.56 million. Deaths are projected to increase from approximately 782,000 to 1.37 million — a 74.7% rise that signals a mortality burden growing faster than incidence. Regional heterogeneity is a defining feature of the forecast landscape, with Super-Saharan Africa facing 200% case growth, South Asia a doubling, and high-income countries only 17% absolute growth through 2050. Within this architecture, Southeast Asia, East Asia, and Oceania carries the second largest absolute burden globally at approximately 548,000 new cases in 2024, with a rising age-standardized rate that distinguishes it from the globally flat trajectory.

2.2 Health System Capacity and Oncology Infrastructure Gaps in Low- and Middle-Income Settings

The literature on oncology infrastructure in low- and middle-income countries (LMIC) presents a consistent and convergent picture: rising breast cancer burden is confronting health systems that have substantial constraints in their capacity to detect, diagnose, treat, and manage the disease at the scale that projected incidence demands. Radiotherapy capacity represents one of the most acute and measurable infrastructure deficits. Christ and Willmann (2023) document that twenty-three low- and middle-income countries — encompassing more than 197 million people — have no radiotherapy facilities whatsoever, with an estimated global deficit of 188 megavoltage machines, 85 brachytherapy units, and approximately 3,363 radiation staff required to close the treatment gap. In francophone LMICs specifically, Belkacemi and colleagues (2026) report that 73% of surveyed providers rated radiotherapy services as poor, and fewer than 15% had access to modern techniques such as intensity-modulated radiation therapy.

Diagnostic pathology presents parallel constraints. Belkacemi and colleagues (2026) document pathology turnaround times of four to eight weeks in francophone LMIC settings — intervals that may delay treatment timeliness. Agbedinu and colleagues (2025) and Afaya and colleagues (2022) characterize limited diagnostic services and inadequate infrastructure as widespread and systemic barriers to timely cancer care across diverse LMIC contexts. Multidisciplinary care coordination is similarly underdeveloped. Taib and colleagues (2025) document real-world implementation challenges in Malaysia, while Pramesh and colleagues (2022), Trapani and colleagues (2022), and Abdel-Wahab and colleagues (2024) collectively emphasize that cancer control strategies developed in high-income settings are frequently not transferable to LMIC contexts without substantial adaptation.

The cumulative effect of these infrastructure deficits on clinical outcomes is extensively documented. Across the LMIC literature, average delays of 7.4 months from symptom onset to diagnosis and 4.9 months from diagnosis to treatment initiation have been recorded (Agbedinu et al., 2025) — intervals that systematically increase the probability of advanced-stage presentation. Financial barriers including out-of-pocket costs, travel expenditure, and underfunded public services compound these system-level constraints (Barrios, 2021; Afaya et al., 2022; Erfani et al., 2021). The relevance to the GBD 2023 forecast data for the focus region is direct: the region's death-to-incidence ratio of 29.6% — significantly above the high-income benchmark of 24.6% — reflects the persistent challenges in screening, diagnosis, and treatment capacity documented throughout this literature.

2.3 Early Detection, Screening Coverage, and Stage-at-Diagnosis Disparities

The relationship between early detection, stage at diagnosis, and breast cancer mortality is among the most consistently supported findings in the oncology literature. Income-stratified analyses consistently document that the proportion of localized breast cancers at diagnosis rises sharply with national wealth. Lim and colleagues (2022) report that among 47 Asian countries, the share of localized stage I to II cancers at diagnosis increases from approximately one-third in low-income settings to more than 60% in high-income settings, with more than 70% of cases in Qatar, Singapore, and Japan diagnosed at stage II or below. LMICs frequently diagnose more than 70% of cases at stage III or IV, with five-year survival estimates as low as 12 to 40%, compared to more than 85% in high-income settings (Salama et al., 2026; Chotai et al., 2025).

Screening coverage data reinforce this picture. A systematic review and meta-analysis by Ebrahimoghli and colleagues (2024) estimates that mammography or clinical breast examination uptake in LMICs averages approximately 23%, with the lowest uptake concentrated among low- and lower-middle-income country populations and rural women. The mortality reduction achievable through organized population-based mammographic screening is well-established: Choi and colleagues (2021) found screened Korean women had breast cancer mortality less than half that of unscreened women. A global ecological analysis by Molassiotis and colleagues (2021) across 130 countries found the availability of mammography-based programs was the strongest predictor of lower age-standardized mortality and disability-adjusted life years.

In the Asia-Pacific context specifically, Chotai and colleagues (2025) document region-wide mortality-to-incidence ratios of approximately 0.32, rising to approximately 0.52 in Southeast Asia — directly continuous with the GBD 2023 data computed in this paper. Wee and colleagues (2024) note that many Asia-Pacific countries lack full national breast cancer screening programs, with underuse of existing programs, urban-rural gaps, and workforce shortages attenuating potential mortality gains. A cluster randomized controlled trial in India by Mittra and colleagues (2021) demonstrated that biennial clinical breast examination delivered by primary health workers achieved approximately 30% mortality reduction — establishing an evidence base for context-appropriate early detection in settings where mammographic infrastructure cannot be rapidly scaled.

2.4 Workforce Analytics, Digital Health, and Technology Integration in Oncology Planning

AI-assisted mammography represents the area of most robust empirical support in the digital health literature. Dembrower and colleagues (2023), reporting from a Swedish population-based study, found that AI-supported reading was non-inferior to double reading while meaningfully reducing the volume of studies requiring human review. A nationwide real-world implementation study by Eisemann and colleagues (2025) found AI integration increased cancer detection by approximately 20% while cutting radiologist workload by nearly half. Chang and colleagues (2025), in a Korean multicenter prospective cohort, documented a 13.8% increase in cancer detection rate with no increase in recall rate when AI-computer-aided detection was added to single-reading programs.

Digital pathology presents a similarly promising evidence base. Trapani and colleagues (2024) document an estimated 13% productivity gain through AI-enhanced digital pathology workflows. The generalizability of these applications to LMIC and Asia-Pacific contexts, however, is not automatic. Yang and colleagues (2023), evaluating AI model performance across United Kingdom and Vietnamese hospital contexts, document that models trained in high-income settings may underperform in LMIC environments unless locally adapted — underscoring the need for contextual tailoring rather than direct technology transfer.

Workforce analytics and health system modeling for oncology capacity planning represent an area of conceptual advancement but limited comparative empirical evidence. Asamani and colleagues (2021), in a systematic scoping review of needs-based health workforce planning models, note that only 16% of applications are in LMIC settings and very few are oncology-specific. Mokashi and colleagues (2025) provide a compelling single-institution example in which discrete-event simulation was used to redesign inpatient oncology capacity, achieving reduced admission wait times. Leerapan and colleagues (2021), modeling Thailand's health workforce using system dynamics methods, demonstrate how simulation can reveal counterintuitive policy implications — including the system-reinforcing inefficiencies of hospital-centric workforce distribution — directly relevant to the region's planning challenge. Adjacent health workforce research similarly argues that forecasting, pipeline bottleneck analysis, and competency readiness mapping are necessary to connect training investments with staffing outcomes (Atento, Quinto, & Espelita, 2025). This planning problem also extends upstream into health professions education, where faculty capacity, clinical placement scarcity, curriculum-practice alignment, and licensure-oriented quality assurance can constrain the production of workforce-ready graduates (Bermido et al., 2025).

2.5 Policy Frameworks and Governance for Breast Cancer Control in Asia-Pacific

The policy and governance literature on breast cancer control in Asia-Pacific illuminates a landscape of profound heterogeneity. Gatellier and colleagues (2025), surveying the 21 member countries of the Asian National Cancer Centers Alliance, document that while most countries have some form of cancer control plan, implementation and evaluation mechanisms are highly uneven. Thailand's national cancer control program, integrating early detection, treatment capacity development, and cancer registry strengthening within its universal health coverage framework, is cited as a model of coordinated policy implementation in a middle-income setting (Insamran & Sangrajrang, 2020; Wee et al., 2024). In contrast, many Southeast Asian lower-income settings lack robust national cancer control plans and have very low screening coverage rates (Bhandari et al., 2024; Ho et al., 2022; Youlden et al., 2014).

The relationship between governance quality, universal health coverage, and breast cancer outcomes is established across several convergent lines of evidence. Ong and colleagues (2023), analyzing data across 21 Asian National Cancer Centers Alliance member countries, find that the proportion of stage I to II breast cancer at diagnosis and five-year survival are positively correlated with UHC index scores. The ASEAN Costs in Oncology study found that 24 to 68% of participants across eight Southeast Asian lower- and middle-income countries experienced financial catastrophe attributable to cancer care costs, with one-year mortality rates of 12 to 45% (Bhoo-Pathy et al., 2017). Chanakira and colleagues (2024) find consistent evidence that subsidizing or eliminating screening fees increases uptake and that patient navigation combined with financial support improves care timeliness and continuity — policy instruments directly applicable to the financing design challenge facing the region's lower-income health systems. Comparable Philippine hospital-accreditation evidence suggests that quality-improvement systems may be favorably viewed while still being constrained operationally by staffing, budget, equipment, documentation, and process-management burdens (Garcia & Atento, 2026).

2.6 Synthesis of Literature

The five thematic bodies of literature converge on analytically coherent and mutually reinforcing conclusions. The first and most structurally important convergence concerns the relationship between health system capacity and the translation of rising incidence into preventable mortality. Across Themes 2, 3, and 5, the literature consistently demonstrates that the death-to-incidence ratio is not a fixed epidemiological parameter but a modifiable system performance indicator, reflecting stage-at-diagnosis distributions, screening coverage, infrastructure availability, care coordination quality, and financial protection architecture. The literature makes clear that where these conditions improve — as in South Korea, Japan, Australia, and Taiwan — the ratio narrows and survival improves.

The second convergence concerns the central and non-substitutable role of early detection. Organized population-based screening produces stage down-shift and mortality reduction at the population level. Where mammographic infrastructure cannot be rapidly scaled, structured clinical breast examination programs delivered by primary health workers represent an evidence-supported alternative. The policy literature reinforces that screening coverage gains require not only infrastructure investment but governance architecture — national cancer control plans, organized program design, and financing mechanisms that remove cost as a barrier to participation.

A productive tension in the literature concerns the sequencing and prioritization of health system investments in resource-constrained settings. One strand emphasizes the primacy of treatment infrastructure as the rate-limiting constraint on survival improvement. A second strand prioritizes early detection as the leverage point that can reduce mortality even in settings where treatment capacity is imperfect, by shifting the stage distribution toward cases that respond better to available interventions. This tension reflects genuine strategic uncertainty about the optimal sequence of investment in settings where resources are insufficient to pursue all priorities simultaneously.

2.7 Gaps in the Literature

Despite the analytical richness of the literature reviewed, several important gaps remain. First, the majority of published analyses are either retrospective epidemiological descriptions or policy reviews anchored in current rather than projected conditions. No published study has used the GBD 2023 forecast data to derive structured, regionally disaggregated health system planning implications for Southeast Asia, East Asia, and Oceania — a gap this paper directly addresses. Second, the death-to-incidence ratio as a health system performance proxy tracking its projected change over time has not been systematically applied to the GBD forecast data. Third, the literature on AI-assisted diagnostics and workforce modeling operates largely independently of the epidemiological forecasting literature. Fourth, direct causal evidence from controlled comparisons of countries with and without national cancer control plans on breast cancer-specific mortality outcomes is largely absent. Fifth, Pacific island nations and smaller Southeast Asian economies receive minimal analytical attention within regional analyses, creating a subnational blind spot.

2.8 Contribution of the Present Paper

This paper makes four analytically distinct contributions. First, it provides the first structured secondary data analysis of the GBD 2023 Breast Cancer Forecasts specifically oriented toward health system planning implications for Southeast Asia, East Asia, and Oceania. Second, it contributes a systematic comparative framing of breast cancer burden trajectories across all eight GBD super-regions simultaneously. Third, it integrates the forecast data with the literature on health system capacity, early detection, digital health, and policy governance to generate structured decision implications for health system planners, oncology administrators, and policymakers in the region. Fourth, it contributes to the IJHBA readership's engagement with applied health analytics by demonstrating how a publicly released global burden dataset can be systematically analyzed to generate actionable regional planning intelligence. This positioning is consistent with integrated healthcare analytics scholarship that treats data integration, analytics capability, and decision quality as mechanisms for linking clinical and organizational outcomes (Atento, Quinto, Espelita, & Castaneda, 2025).

3. Methodology

3.1 Research Design

This study employs a secondary data analysis design using a publicly released, peer-reviewed epidemiological forecasting dataset as its primary analytical source. Secondary data analysis is an established and methodologically recognized approach in health analytics, epidemiology, and health policy research. It is particularly appropriate when the primary data source is of high methodological quality, when the analytical questions of the present study can be addressed through structured interrogation of the available variables, and when the research objective is to derive decision-relevant insights from existing data rather than to generate new primary observations. All three conditions are satisfied in this study. The analytical orientation of the paper is descriptive, comparative, and interpretive. It does not construct an original forecasting model, generate new epidemiological projections, or perform inferential statistical testing.

3.2 Data Source and Provenance

The primary data source is the Global Burden of Disease Study 2023 Breast Cancer Forecasts 2024–2050, released on March 2, 2026, by the Institute for Health Metrics and Evaluation at the University of Washington, Seattle (Global Burden of Disease Collaborative Network, 2026). The dataset was produced as part of a systematic analysis of the global burden of breast cancer among females from 1990 to 2023, with forward projections to 2050, published simultaneously in The Lancet Oncology (GBD 2023 Breast Cancer Collaborators, 2026). The forecasting methodology involves compiling GBD 2021 forecasted values and applying intercept-shifting to align projections with GBD 2023 baseline results, producing forward estimates from 2024 through 2050 with 95% uncertainty intervals derived from the 2.5th and 97.5th percentile distributions of the underlying model ensemble.

The dataset is structured at the super-regional level, covering eight geographic units: Global, High-income, Central Europe, Eastern Europe and Central Asia, Latin America and Caribbean, North Africa and Middle East, South Asia, Southeast Asia, East Asia and Oceania, and Sub-Saharan Africa. All estimates are restricted to the female sex. The dataset contains 864 observations across 16 variables. No institutional ethical approval is required for secondary analysis of publicly released, de-identified aggregate epidemiological data of this nature.

3.3 Variable Selection and Analytical Scope

Four primary variable dimensions are engaged. The measure dimension encompasses incidence (annual new cases) and deaths (annual mortality). The metric dimension encompasses number (absolute counts) and rate (age-standardized estimates per 100,000 females). The age group dimension encompasses all ages and age-standardized. The year dimension spans 2024 through 2050 in annual increments, yielding 27 forecast years per analytical combination. Three temporal anchor points — 2024, 2035, and 2050 — are used as primary reference years for comparative tabulation, with the full annual series retained for trend characterization.

3.4 Analytical Procedures

Five analytical procedures are applied. (1) Descriptive regional profiling characterizes the breast cancer incidence and mortality burden of each super-region at the 2024 baseline. (2) Absolute burden trajectory analysis tracks the change in all-ages incidence counts and death counts from 2024 to 2050, computing absolute increments and percentage changes. (3) Age-standardized rate trajectory analysis tracks the change in age-standardized incidence and mortality rates, enabling comparison independent of population size and age structure effects. (4) Death-to-incidence ratio analysis computes the ratio of all-ages deaths to all-ages incident cases at 2024, 2035, and 2050, treating this ratio as a proxy indicator of health system performance. (5) Comparative convergence and divergence analysis examines whether age-standardized rates in the focus region are converging toward or diverging from the global average and the high-income country benchmark. All computations are performed using Python, with uncertainty interval bounds reported throughout.

3.5 Literature Integration Framework

The secondary data analysis is integrated with the thematic literature review through a structured interpretive framework. Analytical findings derived from the GBD 2023 dataset are systematically connected to the literature evidence on health system capacity deficits, early detection mechanisms, digital health tools, and governance frameworks to generate health system planning implications. This integration is explicitly interpretive rather than inferential — the literature contextualizes and explains observed data patterns rather than testing statistical associations between dataset variables and health system characteristics.

3.6 Limitations

Several limitations must be acknowledged. First, the dataset is structured at the super-regional level and does not contain national-level disaggregation. Conclusions apply to the aggregate regional trajectory and cannot be attributed to any specific country within the region. Second, the forecasts represent probabilistic projections, not observed outcomes, and uncertainty intervals widen substantially toward 2050. Third, the death-to-incidence ratio is not equivalent to a formally computed case fatality rate and is affected by the lag between incidence and mortality, age structure changes, and differences in underlying data sources. Fourth, this paper does not perform causal analysis and cannot attribute changes in forecast burden trajectories to specific health system characteristics.

4. Results

4.1 Global Breast Cancer Forecast Trends, 2024–2050

The GBD 2023 Breast Cancer Forecasts project a sustained and substantial escalation in global breast cancer incidence and mortality among females across the 27-year forecast horizon. Globally, annual new breast cancer cases are projected to rise from approximately 2.34 million (95% UI: 2.04–2.67 million) in 2024 to approximately 2.89 million (95% UI: 2.32–3.50 million) by 2035, reaching approximately 3.56 million (95% UI: 2.29–4.83 million) by 2050 — a central estimate increase of 1.22 million cases representing a 52.1% rise. Breast cancer deaths are projected to increase from approximately 782,000 in 2024 to approximately 1.37 million by 2050 — a 74.7% increase that outpaces the rate of incidence growth, signaling a widening gap between new cases and system capacity to convert them into survivable outcomes.

Global age-standardized incidence rates remain essentially flat across the forecast horizon — 49.3 per 100,000 females in 2024, 49.0 in 2035, and 49.1 in 2050 — indicating that absolute burden escalation is driven primarily by demographic factors rather than by changes in underlying disease risk rates. The age-standardized mortality rate shows a modest upward drift from 16.1 to 16.7 per 100,000, suggesting that global-average health system performance is projected to remain broadly stable but not to improve substantially. The global death-to-incidence ratio rises from 33.4% in 2024 to 38.3% by 2050, driven by the faster growth of burden in regions with more constrained health system capacity.

4.2 Regional Comparative Profiles: Incidence and Mortality Trajectories

Disaggregated by super-region, the GBD 2023 forecasts reveal markedly divergent trajectories in both the magnitude and pace of breast cancer burden growth.

Table 1. Projected Breast Cancer Incidence Among Females by Super-Region, 2024–2050 (All Ages, Number)

Super-Region	2024 (95% UI)	2035 (95% UI)	2050 (95% UI)	Change 2024–2050
Global	2,343,245 (2,043,600–2,669,623)	2,889,584 (2,321,668–3,497,617)	3,564,264 (2,291,897–4,826,388)	+1,221,019 (+52.1%)
High-income	825,651 (715,940–931,300)	916,243 (774,067–1,049,713)	962,970 (802,996–1,122,029)	+137,319 (+16.6%)
SE Asia, E Asia & Oceania	547,920 (460,062–636,857)	667,886 (547,872–798,024)	788,623 (609,816–969,397)	+240,704 (+43.9%)
South Asia	295,420 (231,699–368,841)	421,259 (301,238–552,221)	591,989 (344,452–862,238)	+296,568 (+100.4%)
Sub-Saharan Africa	214,122 (154,702–285,190)	348,132 (229,656–483,899)	643,426 (369,415–982,271)	+429,305 (+200.5%)
Cen./E. Europe & C. Asia	171,927 (152,280–190,056)	186,593 (159,269–213,885)	189,499 (140,011–233,249)	+17,572 (+10.2%)
Lat. America & Caribbean	158,143 (140,960–178,281)	206,369 (172,581–249,486)	269,134 (196,566–360,645)	+110,990 (+70.2%)
N. Africa & Middle East	133,161 (105,474–162,657)	194,004 (140,550–249,453)	291,284 (156,460–427,356)	+158,123 (+118.7%)

Source: Global Burden of Disease Collaborative Network (2026). Authors' computation of percentage changes.

Table 2. Projected Breast Cancer Deaths Among Females by Super-Region, 2024–2050 (All Ages, Number)

Super-Region	2024 (95% UI)	2035 (95% UI)	2050 (95% UI)	Change 2024–2050
Global	782,478 (687,614–875,493)	1,009,981 (786,502–1,252,727)	1,366,615 (841,226–2,022,955)	+584,137 (+74.7%)

Super-Region	2024 (95% UI)	2035 (95% UI)	2050 (95% UI)	Change 2024–2050
High-income	202,941 (176,871–224,114)	236,646 (198,993–272,271)	269,471 (216,723–332,906)	+66,530 (+32.8%)
SE Asia, E Asia & Oceania	162,454 (136,431–184,483)	203,073 (164,427–238,328)	260,775 (183,959–335,345)	+98,321 (+60.5%)
South Asia	145,320 (115,450–179,798)	206,151 (138,728–280,078)	304,479 (142,183–495,929)	+159,159 (+109.5%)
Sub-Saharan Africa	109,327 (77,446–143,348)	173,903 (117,998–240,790)	322,359 (164,826–490,122)	+213,032 (+194.9%)
Cen./E. Europe & C. Asia	63,421 (58,655–67,057)	72,021 (63,777–78,445)	77,979 (61,274–92,628)	+14,558 (+23.0%)
Lat. America & Caribbean	57,607 (53,922–60,392)	75,493 (67,079–81,969)	101,464 (81,348–117,946)	+43,856 (+76.1%)
N. Africa & Middle East	42,538 (34,632–50,671)	62,041 (45,221–79,294)	97,911 (48,210–153,637)	+55,373 (+130.2%)

Source: Global Burden of Disease Collaborative Network (2026). Authors' computation of percentage changes.

High-income countries, which carry the largest absolute incidence burden in 2024 at approximately 826,000 cases, are projected to experience the most modest relative growth — 16.6% in incidence and 32.8% in deaths through 2050. Sub-Saharan Africa and South Asia present the most acute trajectories: Sub-Saharan Africa projects a 200.5% increase in incidence and 194.9% increase in deaths, while South Asia faces a projected doubling of both incidence (100.4%) and deaths (109.5%). North Africa and Middle East projects 118.7% incidence growth and 130.2% death growth. Southeast Asia, East Asia, and Oceania records the second largest absolute burden in 2024 and is projected to add approximately 241,000 annual cases and 98,000 annual deaths by 2050.

4.3 Southeast Asia, East Asia, and Oceania: Burden Characterization and Trend Signals

Southeast Asia, East Asia, and Oceania occupies a distinctive position within the global forecast landscape. In 2024, the region records approximately 547,920 new cases (95% UI: 460,062–636,857) and 162,454 deaths (95% UI: 136,431–184,483). By 2035, cases are projected to reach 667,886 (95% UI: 547,872–798,024) and deaths 203,073 (95% UI: 164,427–238,328). By 2050, the central projection reaches 788,623 cases (95% UI: 609,816–969,397) and 260,775 deaths (95% UI: 183,959–335,345) — representing absolute increases of 240,704 cases (+43.9%) and 98,321 deaths (+60.5%) over the forecast horizon.

The magnitude of this absolute growth deserves emphasis independent of its percentage representation. An additional 240,000 annual breast cancer cases by 2050 constitutes a structural expansion of oncological demand equivalent in scale to the entire current annual breast cancer burden of South Asia — projected onto a regional health system already managing the second largest absolute caseload outside high-income settings. Similarly, an additional 98,000 annual deaths by 2050 represents a mortality escalation that, if not intercepted by health system expansion and early detection improvements, will materialize as preventable excess mortality concentrated disproportionately in the region's lower-income sub-populations.

4.4 Age-Standardized Rate Trajectories: Convergence and Divergence Patterns

Table 3. Age-Standardized Incidence Rates by Super-Region, 2024–2050 (per 100,000 Females)

Super-Region	2024 (95% UI)	2035 (95% UI)	2050 (95% UI)	Direction
Global	49.27 (43.40–55.98)	49.03 (40.45–58.59)	49.12 (35.10–63.95)	Flat
High-income	82.29 (72.81–92.73)	82.32 (72.25–93.54)	82.36 (72.13–95.36)	Flat
Sub-Saharan Africa	53.92 (38.94–71.73)	58.26 (38.35–80.20)	62.80 (34.87–93.84)	Rising
Cen./E. Europe & C. Asia	47.83 (41.99–52.99)	47.67 (40.44–54.93)	46.49 (33.85–56.56)	Slightly declining
N. Africa & Middle East	45.60 (36.13–55.91)	48.33 (34.63–62.66)	51.00 (28.51–73.39)	Rising
Lat. America & Caribbean	43.34 (38.38–48.84)	44.98 (37.06–54.28)	47.49 (34.40–63.21)	Slightly rising
SE Asia, E Asia & Oceania	35.62 (30.14–41.70)	37.58 (30.96–44.50)	40.87 (32.39–49.84)	Rising
South Asia	33.43 (26.14–42.13)	36.35 (25.62–47.59)	38.47 (20.52–57.62)	Rising

Source: Global Burden of Disease Collaborative Network (2026).

Table 4. Age-Standardized Mortality Rates by Super-Region, 2024–2050 (per 100,000 Females)

Super-Region	2024 (95% UI)	2035 (95% UI)	2050 (95% UI)	Direction
Global	16.12 (14.11–18.10)	16.19 (13.14–19.90)	16.73 (11.34–24.05)	Slightly rising
Sub-Saharan Africa	29.79 (20.98–39.03)	31.26 (20.45–43.95)	32.79 (17.94–50.90)	Rising
South Asia	17.35 (13.42–21.56)	18.19 (11.95–25.17)	18.91 (7.93–31.87)	Rising
High-income	16.50 (14.83–18.07)	15.98 (14.00–18.35)	15.53 (13.15–19.23)	Declining
Cen./E. Europe & C. Asia	16.29 (15.13–17.14)	15.99 (14.20–17.35)	15.18 (12.36–17.56)	Declining
N. Africa & Middle East	15.65 (12.71–18.66)	15.97 (11.25–20.84)	16.54 (8.59–25.75)	Slightly rising
Lat. America & Caribbean	15.65 (14.63–16.37)	15.38 (13.53–16.69)	15.16 (12.22–17.64)	Slightly declining
SE Asia, E Asia & Oceania	10.30 (8.69–11.66)	10.49 (8.44–12.30)	11.29 (8.18–14.33)	Rising

Source: Global Burden of Disease Collaborative Network (2026).

The age-standardized rate data reveal two analytically important patterns for Southeast Asia, East Asia, and Oceania. First, the region's age-standardized incidence rate is rising — from 35.62 per 100,000 in 2024 to 40.87 by 2050 — at a time when the global average remains flat at approximately 49 per 100,000 and the high-income benchmark is essentially stationary at 82.3. This rising rate indicates an underlying epidemiological transition toward higher breast cancer risk rates — a convergence dynamic that will accelerate absolute burden accumulation beyond what demographic projections alone would predict. Second, the region's age-standardized mortality rate, while the lowest of any super-region at 10.30 per 100,000 in 2024, is rising toward 11.29 by 2050 — moving in the opposite direction to high-income countries (15.53, declining). This divergence signals that the region's health system capacity to convert incidence into survival is not keeping pace with epidemiological transition.

4.5 Death-to-Incidence Ratios as Health System Performance Proxies

Table 5. Death-to-Incidence Ratios by Super-Region, 2024–2050

Super-Region	2024	2035	2050	Trend
Sub-Saharan Africa	51.1%	50.0%	50.1%	Persistently high
South Asia	49.2%	48.9%	51.4%	Persistently high, rising by 2050
Cen./E. Europe & C. Asia	36.9%	38.6%	41.2%	Rising
Lat. America & Caribbean	36.4%	36.6%	37.7%	Slowly rising
Global	33.4%	35.0%	38.3%	Rising
N. Africa & Middle East	31.9%	32.0%	33.6%	Slowly rising
SE Asia, E Asia & Oceania	29.6%	30.4%	33.1%	Rising
High-income	24.6%	25.8%	28.0%	Rising moderately

Source: Global Burden of Disease Collaborative Network (2026). Authors' computation.

Southeast Asia, East Asia, and Oceania records the second lowest death-to-incidence ratio of any super-region in 2024 at 29.6% — substantially below the global average of 33.4% and the ratios recorded in South Asia (49.2%) and Sub-Saharan Africa (51.1%). However, the trajectory of this ratio is concerning: it rises from 29.6% in 2024 to 30.4% in 2035 and 33.1% by 2050 — a deterioration of 3.5 percentage points. By 2050, the region's ratio approaches the current global average, indicating convergence not toward the high-income benchmark of 24.6% but toward the less favorable global mean. For Southeast Asia, East Asia, and Oceania, both the ratio and the age-standardized mortality rate are rising simultaneously, indicating that system performance is not improving at a pace commensurate with the epidemiological transition underway.

4.6 Discussion

Interpreting the Forecast Patterns in the Context of the Literature

The results of this analysis present a regional health system challenge that is analytically distinguishable from the challenges confronting other super-regions in both its structure and its tractability. Southeast Asia, East Asia, and Oceania is not the fastest-growing region in relative terms — Sub-Saharan Africa and South Asia face far steeper proportional trajectories — nor does it carry the highest absolute incidence burden, which remains concentrated in high-income countries. What makes the region's trajectory analytically significant is the combination of three simultaneous pressures: a rising age-standardized incidence rate indicating genuine epidemiological transition beyond demographic effects alone; a rising death-to-incidence ratio indicating that health system performance is not improving commensurately; and an absolute scale of burden — second only to high-income countries globally — that makes the gap between current health system capacity and projected demand a quantitatively consequential planning problem. Comparable ASEAN development-health evidence further suggests that macroeconomic strength does not automatically translate into equitable health outcomes unless mediated by inclusive labor systems, family-responsive policy, and social-protection capacity (Quinto & Atento, 2025).

The rising age-standardized incidence rate, increasing from 35.6 to 40.9 per 100,000 between 2024 and 2050, is consistent with patterns documented in the epidemiological literature connecting urbanization, changing reproductive behaviors, increasing body mass index, and the adoption of Western lifestyle risk factor profiles to breast cancer incidence growth in transitioning economies (Lim et al., 2022; Youlden et al., 2014). This epidemiological convergence toward higher-income incidence levels is occurring within a region where health system capacity — particularly in the lower-income sub-regions of Southeast Asia and the Pacific — has not undergone a parallel convergence. The projection that the region's death-to-incidence ratio will rise from 29.6% in 2024 to 33.1% by 2050 is particularly informative when read against the high-income country trajectory. For high-income countries, even as the ratio rises from 24.6% to 28.0%, the age-standardized mortality rate simultaneously declines — meaning survival probability conditional on diagnosis is improving. For Southeast Asia, East Asia, and Oceania, both metrics are rising together, indicating genuine deterioration in the aggregate survival probability across the regional population.

The Early Detection Imperative and Its Health System Preconditions

The analytical case for prioritizing early detection infrastructure investment in Southeast Asia, East Asia, and Oceania emerges clearly from the convergence of the forecast data and the literature. If the death-to-incidence ratio trajectory is to be interrupted or reversed, the primary mechanism available to health system planners is the systematic shift of stage-at-diagnosis distribution from advanced to early-stage disease — a shift that requires organized population-based screening programs, financially protected access, and diagnostic pathway capacity sufficient to convert screen-detected abnormalities into timely pathological confirmation and treatment initiation. The literature establishes that this shift is achievable: organized mammographic screening in South Korea has been associated with breast cancer mortality rates less than half those of unscreened women (Choi et al., 2021), and structured clinical breast examination delivered by trained primary health workers achieved approximately 30% mortality reduction in an Indian cluster randomized trial (Mittra et al., 2021). These gains, however, require governance and financing preconditions: national cancer control plans with organized screening components, UHC financing that eliminates cost barriers, and patient navigation systems that ensure screen-detected findings lead to completed diagnostic and treatment pathways (Ong et al., 2023; Bhoo-Pathy et al., 2017).

The Role of Digital Health and AI in Closing the Diagnostic Capacity Gap

With the projected expansion in health system demands, exploring technologies that may augment screening and diagnostic capacity is warranted. AI-assisted mammography and digital pathology workflows offer demonstrable potential to extend diagnostic capacity without requiring proportional expansion of specialist oncology workforce. The evidence that AI-assisted mammographic triage can maintain or improve cancer detection sensitivity while reducing radiologist reading load by meaningful proportions (Eisemann et al., 2025; Dembrower et al., 2023; Chang et al., 2025) is analytically significant for a region where radiologist density is a documented constraint on screening expansion. However, the documented performance degradation of high-income-trained AI models when deployed in LMIC imaging environments (Yang et al., 2023) establishes a critical implementation boundary: technology transfer without local validation and adaptation is not a viable shortcut to diagnostic capacity expansion. The development of regionally trained and validated AI tools represents the strategically sound path, requiring investment in local data infrastructure, model development partnerships, and evaluation frameworks.

Policy Governance and Financing as Enabling Architecture

The governance and financing literature converges on a conclusion that is simple to state but organizationally demanding to implement: early detection infrastructure without financial protection for access is epidemiologically incomplete. The ASEAN Costs in Oncology study's documentation of financial catastrophe rates of 24 to 68% across Southeast Asian LMIC settings (Bhoo-Pathy et al., 2017) establishes that even where diagnostic capacity exists, the absence of adequate financial protection converts potential early detection gains into a system that detects disease but cannot ensure that detection leads to timely treatment. The policy response therefore extends to the architecture of UHC financing — specifically, the inclusion of breast cancer screening and diagnostic follow-up within national health insurance benefit packages and the extension of those schemes to informal sector workers and rural populations who currently face the highest barriers to access. In the Philippine context, UHC reform also interacts with private-sector access intermediaries, including retail pharmacy actors whose strategic adaptation to affordability policy and digital disruption may affect medicine accessibility and service convenience (Atento & Atento, 2025).

Limitations of the Analysis

Several limitations constrain the conclusions of this study. The super-regional level of the GBD 2023 dataset precludes national-level analysis, masking the profound heterogeneity within the focus super-region. The widening uncertainty intervals in the 2050 projections reflect genuine model uncertainty, and central estimates toward the far end of the forecast horizon should be treated as planning scenarios rather than precise predictions. The death-to-incidence ratio is not a formally computed case fatality measure and is subject to cross-sectional limitations described in the methodology. Finally, this paper does not perform causal inference and cannot attribute changes in forecast burden trajectories to specific health system characteristics.

5. Conclusions and Recommendations

5.1 Conclusions

This paper has applied a structured secondary data analysis of the GBD 2023 Breast Cancer Forecasts to characterize the projected trajectory of female breast cancer incidence and mortality across global super-regions from 2024 to 2050, with focused analytical attention on the implications of that trajectory for health system preparedness in Southeast Asia, East Asia, and Oceania. Four conclusions emerge with sufficient analytical support to warrant the attention of health system planners, policymakers, and oncology administrators in the region.

First, the global breast cancer burden is on a trajectory of sustained and substantial escalation driven overwhelmingly by demographic expansion. Global incidence is projected to rise 52.1% and deaths 74.7% between 2024 and 2050. The divergence between incidence and mortality growth rates signals a global deterioration in the aggregate ratio of deaths to new cases — a regionally differentiated phenomenon driven by the concentration of future burden growth in regions where health system absorptive capacity is most constrained.

Second, Southeast Asia, East Asia, and Oceania carries the second largest absolute breast cancer burden of any super-region and is projected to add approximately 241,000 new annual cases and 98,000 new annual deaths by 2050. The region's age-standardized incidence rate is rising while the global average remains flat, indicating an epidemiological convergence toward higher-burden levels driven by risk factor transitions. The region's death-to-incidence ratio is simultaneously rising from 29.6% to 33.1%, approaching the current global average in a direction opposite to declining age-standardized mortality rates in high-income settings. This combination constitutes the paper's central analytical warning: the region is growing its caseload faster than its aggregate health system performance can absorb.

Third, the mechanisms linking rising incidence to preventable mortality are well established in the literature and directly applicable to the region's situation. Stage at diagnosis is the primary determinant of breast cancer survival, and it is a function of screening coverage, program organization, financial access, and diagnostic pathway capacity — all of which are unevenly distributed across the super-region and systematically deficient in its lower-income sub-regions. The mortality excess documented in the death-to-incidence ratio is not an immutable epidemiological feature but a modifiable health system outcome.

Fourth, the technologies and governance instruments required to interrupt the projected mortality trajectory are available, evidence-supported, and increasingly feasible within constrained resource environments. The analytical challenge is not the absence of solutions but the urgency and specificity with which they must be designed and implemented against a forecast horizon in which the window for intercepting the mortality trajectory is narrowing with each year of planning delay.

5.2 Recommendations

1. Establish forecast-anchored national breast cancer burden projections for health system planning. Health ministries and national cancer control authorities should use the GBD 2023 regional projections as a planning baseline and commission national-level burden projections to translate super-regional forecasts into country-specific planning targets for screening programs, treatment infrastructure, and workforce requirements.
2. Accelerate the implementation and financing of organized national breast cancer screening programs in lower-income Southeast Asian settings. For settings where mammographic infrastructure cannot be rapidly scaled, structured clinical breast examination delivered by trained primary health workers represents an evidence-supported entry point. Financing arrangements must eliminate or substantially subsidize out-of-pocket costs at the point of screening participation and diagnostic follow-up.
3. Integrate breast cancer screening and treatment within UHC benefit packages and extend coverage to informal sector and rural populations. Health financing authorities should audit the actual coverage conditions of existing

national health insurance schemes for breast cancer services and close identified gaps as a policy priority aligned with the projected burden escalation through 2050.

4. Invest in locally adapted AI diagnostic tools and digital health infrastructure for screening program capacity expansion. Regional health technology authorities and academic medical centers should prioritize the development, local validation, and implementation of AI-assisted mammography triage and digital pathology tools calibrated to Southeast Asian health system environments, given the documented performance degradation of high-income-trained models in LMIC contexts.
5. Apply workforce analytics and system modeling to oncology capacity planning. National health workforce planning authorities should commission needs-based oncology workforce projection models incorporating the GBD 2023 incidence and mortality forecasts as demand-side inputs, applying system dynamics modeling to identify counterintuitive system inefficiencies and high-leverage reallocation strategies.
6. Strengthen cancer registry infrastructure and performance monitoring frameworks across the region. Regional investments in cancer registry strengthening, aligned with the performance indicator framework of the Asian National Cancer Centers Alliance, would materially improve the evidence base for national planning and regional policy coordination.

5.3 Directions for Future Research

Future research should pursue national-level decomposition of the regional burden trajectory using country-specific GBD estimates and national registry data. Modeling studies that translate projected burden trajectories into specific workforce, infrastructure, and financing requirement estimates — under defined scenarios of screening coverage expansion and treatment access improvement — would substantially advance the planning utility of the epidemiological forecast data. Prospective evaluation studies of organized breast cancer screening programs in lower-income Southeast Asian contexts would provide the locally generated evidence base that the current literature cannot supply. Finally, health economics analyses quantifying the cost-effectiveness of different early detection strategy combinations against the projected burden in lower-resource Southeast Asian settings would directly inform the financing and policy design recommendations derived from this analysis.

References

Abdel-Wahab, M., Coleman, C. N., Eriksen, J. G., et al. (2024). Addressing challenges in low-income and middle-income countries through novel radiotherapy research opportunities. The Lancet Oncology, 25(6), e270–e280. https://doi.org/10.1016/s1470-2045(24)00038-x

Afaya, A., Ramazanu, S., Bolarinwa, O. A., et al. (2022). Health system barriers influencing timely breast cancer diagnosis and treatment among women in low and middle-income Asian countries. BMC Health Services Research, 22. https://doi.org/10.1186/s12913-022-08927-x

Agbedinu, K., Antwi, S., Aduse-Poku, L., et al. (2025). A scoping review on barriers to cancer diagnosis and care in low- and middle-income countries. Cancer Epidemiology, Biomarkers & Prevention. https://doi.org/10.1158/1055-9965.epi-25-0120

Asamani, J., Christmals, C., & Reitsma, G. (2021). The needs-based health workforce planning method: a systematic scoping review of analytical applications. Health Policy and Planning. https://doi.org/10.1093/heapol/czab022

Atento, A. G., & Atento, R. G. (2025). A case study of Mercury Drug Corporation: Strategic adaptation to universal healthcare and digital disruption in the Philippines. International Journal of Health & Business Analytics, 1(1). https://doi.org/10.65166/zhw7dd39

Atento, R. G., Quinto, L., Espelita, C. A. M., & Castaneda, C. (2025). Integrating business and health analytics: A conceptual framework for dual outcomes in healthcare. International Journal of Health & Business Analytics, 1(1). https://doi.org/10.65166/04pdc866

Atento, R. G. O., Quinto, L. F., & Espelita, C. A. M. H. (2025). Bridging global health workforce gaps 2050: A multilevel analysis of global demand, Philippine supply fragilities, and competency alignment. International Journal of Health and Business Analytics, 1(2), 1–30. https://doi.org/10.65166/kgbpey79

Barrios, C. (2021). Global challenges in breast cancer detection and treatment. The Breast, 62, S3–S6. https://doi.org/10.1016/j.breast.2022.02.003

Belkacemi, Y., Ceugnart, L., Bellefkih, F. Z., et al. (2026). Inventory and needs assessment in francophone LMICs for education, screening and optimal management of breast cancer: The ELISA study. Bulletin du Cancer. https://doi.org/10.1016/j.bulcan.2026.01.009

Bermido, C. M., Quinto, L. F., & Atento, R. G. O. (2025). A qualitative thematic review of contemporary challenges affecting health professions education: Implications for higher education leadership. International Journal of Health and Business Analytics, 1(2). https://doi.org/10.65166/yfm5w791

Bhandari, A. K. C., Htay, Z. W., Parvin, R., et al. (2024). Prevalence of breast cancer screening in Asia: systematic review and meta-analysis. Asian Pacific Journal of Cancer Prevention, 25, 3379–3391.

Bhoo-Pathy, N., Yip, C.-H., Peters, S., et al. (2017). Policy and priorities for national cancer control planning in low- and middle-income countries: Lessons from the ASEAN Costs in Oncology prospective cohort study. European Journal of Cancer, 74, 26–37. https://doi.org/10.1016/j.ejca.2016.12.014

Bhattacharya, S., Saleem, S., Singh, A., et al. (2024). Empowering precision medicine: regenerative AI in breast cancer. Frontiers in Oncology, 14. https://doi.org/10.3389/fonc.2024.1465720

Cardoso, F. (2025). Access to innovative medicines for advanced breast cancer as a catalyst for health systems strengthening in LMICs. Clinical Cancer Research. https://doi.org/10.1158/1557-3265.sabcs24-ps10-06

Chang, Y.-W., Ryu, J. K., An, J. K., et al. (2025). Artificial intelligence for breast cancer screening in mammography (AI-STREAM). Nature Communications, 16. https://doi.org/10.1038/s41467-025-57469-3

Chanakira, E., Thomas, C., Balen, J., & Mandrik, O. (2024). A systematic review of public health interventions to address breast cancer inequalities in low- and middle-income countries. Systematic Reviews, 13. https://doi.org/10.1186/s13643-024-02620-2

Choi, E., Jun, J., Suh, M., et al. (2021). Effectiveness of the Korean National Cancer Screening Program in reducing breast cancer mortality. NPJ Breast Cancer, 7. https://doi.org/10.1038/s41523-021-00295-9

Chotai, N., Renganathan, R., Uematsu, T., et al. (2025). Breast cancer screening in Asian countries: epidemiology, screening practices, outcomes, challenges, and future directions. Korean Journal of Radiology, 26, 743–758. https://doi.org/10.3348/kjr.2025.0338

Christ, S., & Willmann, J. (2023). Measuring global inequity in radiation therapy: resource deficits in LMICs without radiation therapy facilities. Advances in Radiation Oncology, 8. https://doi.org/10.1016/j.adro.2023.101175

Cuoghi, I. C., Da Silva Soares, M. F., Santos, G. M. C. D., et al. (2022). 10-year opportunistic mammographic screening scenario in Brazil and its impact on breast cancer early detection. Journal of Global Health, 12. https://doi.org/10.7189/jogh.12.04061

Dembrower, K., Crippa, A., Colon, E., et al. (2023). Artificial intelligence for breast cancer detection in screening mammography in Sweden: a prospective, population-based study. The Lancet Digital Health. https://doi.org/10.1016/s2589-7500(23)00153-x

Ebrahimoghli, R., Aghaei, M., Azami-Aghdash, S., & Houssami, N. (2024). Uptake of breast cancer screening practices in low and middle-income countries: a systematic review and meta-analysis. Journal of the National Cancer Institute. https://doi.org/10.1093/jnci/djae187

Eisemann, N., Bunk, S., Mukama, T., et al. (2025). Nationwide real-world implementation of AI for cancer detection in population-based mammography screening. Nature Medicine, 31, 917–924. https://doi.org/10.1038/s41591-024-03408-6

Erfani, P., Bhangdia, K., Stauber, C., et al. (2021). Economic evaluations of breast cancer care in low- and middle-income countries: a scoping review. The Oncologist, 26, e1406–e1417. https://doi.org/10.1002/onco.13841

Garcia, A. E., & Atento, R. G. O. (2026). Engagement and perceptions of middle managers in PhilHealth Benchbook II accreditation: Evidence from a tertiary hospital case study. Journal of Enterprise Strategy & Management Innovation, 1(1). https://doi.org/10.65166/jev58v44

Gatellier, L., Cairo, C. U., Ong, S., et al. (2025). National cancer control plans in ANCCA member countries: advancing a pan-Asian cancer initiative. The Lancet Global Health, 13(8), e1476–e1483. https://doi.org/10.1016/s2214-109x(25)00192-5

GBD 2023 Breast Cancer Collaborators. (2026). Global, regional, and national burden of breast cancer among females, 1990–2023, with forecasts to 2050: a systematic analysis for the Global Burden of Disease Study 2023. The Lancet Oncology, 2 March 2026.

Global Burden of Disease Collaborative Network. (2026). Global Burden of Disease Study 2023 (GBD 2023) Breast Cancer Forecasts 2024–2050. Institute for Health Metrics and Evaluation (IHME), Seattle, USA.

Gøtzsche, P., & Nielsen, M. (2024). Screening for breast cancer with mammography. The Cochrane Database of Systematic Reviews, 4, CD001877. https://doi.org/10.1002/14651858.cd001877.pub2

Ho, F. D. V., Arevalo, M., De Claro, P. T. S., et al. (2022). Breast and cervical cancer screening in the Philippines: challenges and steps forward. Preventive Medicine Reports, 29. https://doi.org/10.1016/j.pmedr.2022.101936

Hunter, B., Hindocha, S., & Lee, R. (2022). The role of artificial intelligence in early cancer diagnosis. Cancers, 14. https://doi.org/10.3390/cancers14061524

Insamran, W., & Sangrajrang, S. (2020). National Cancer Control Program of Thailand. Asian Pacific Journal of Cancer Prevention, 21, 577–582.

International Agency for Research on Cancer. (2025). Breast cancer cases and deaths projected to rise globally (Press Release No. 361). World Health Organization. https://www.iarc.who.int/wp-content/uploads/2025/02/pr361_E.pdf

Iqbal, J. (2025). Women-centric breast cancer care in low- and middle-income countries: challenges, solutions, and a roadmap for equity. Cancer Control, 32. https://doi.org/10.1177/10732748251378804

Janatolmakan, M., Lashkari, M., Lehto, R., & Negarandeh, R. (2026). Factors associated with delays in breast cancer diagnosis in low- and middle-income countries: a scoping review. International Journal of Community Based Nursing and Midwifery, 14, 22–42.

Kaiser, A. H., Rotigliano, N., Flessa, S., et al. (2023). Extending universal health coverage to informal workers: a systematic review of health financing schemes in low- and middle-income countries in Southeast Asia. PLOS ONE, 18. https://doi.org/10.1371/journal.pone.0288269

Kolla, L., & Parikh, R. (2024). Uses and limitations of artificial intelligence for oncology. Cancer, 130, 2101–2107. https://doi.org/10.1002/cncr.35307

Lee, J. T., Crettenden, I., Tran, M., et al. (2024). Methods for health workforce projection model: systematic review and recommended good practice reporting guideline. Human Resources for Health, 22. https://doi.org/10.1186/s12960-024-00895-z

Leerapan, B., Teekasap, P., Urwannachotima, N., et al. (2021). System dynamics modelling of health workforce planning to address future challenges of Thailand's Universal Health Coverage. Human Resources for Health, 19. https://doi.org/10.1186/s12960-021-00572-5

Li, M., Wang, H., Qu, N., et al. (2024). Breast cancer screening and early diagnosis in China: a systematic review and meta-analysis on 10.72 million women. BMC Women's Health, 24. https://doi.org/10.1186/s12905-024-02924-4

Lim, Y. X., Lim, Z. L., Ho, P., & Li, J. (2022). Breast cancer in Asia: incidence, mortality, early detection, mammography programs, and risk-based screening initiatives. Cancers, 14. https://doi.org/10.3390/cancers14174218

Martinez, M. E., Schmeler, K. M., Lajous, M., & Newman, L. A. (2024). Cancer screening in low- and middle-income countries. American Society of Clinical Oncology Educational Book, 44(3), e431272.

Mishra, G., Pimple, S., Mittra, I., & Badwe, R. (2021). Screening for breast cancer: cost-effective solutions for low- and middle-income countries. The Indian Journal of Medical Research, 154, 229–236.

Mittra, I., Mishra, G., Dikshit, R., et al. (2021). Effect of screening by clinical breast examination on breast cancer incidence and mortality after 20 years: prospective, cluster randomised controlled trial in Mumbai. The BMJ, 372, n256.

Mokashi, A. C., Gardner, G. J., Klotz, A. D., et al. (2025). A simulation-based approach for inpatient capacity management at a hospital dedicated for cancer treatment. Journal of Medical Systems, 49. https://doi.org/10.1007/s10916-025-02206-y

Molassiotis, A., Tyrovolas, S., Gine-Vazquez, I., et al. (2021). Organized breast cancer screening not only reduces mortality but also significantly decreases disability-adjusted life years. ESMO Open, 6. https://doi.org/10.1016/j.esmoop.2021.100111

Ong, S. K., Haruyama, R., Yip, C., et al. (2023). Feasibility of monitoring Global Breast Cancer Initiative Framework key performance indicators in 21 Asian National Cancer Centers Alliance member countries. eClinicalMedicine, 67. https://doi.org/10.1016/j.eclinm.2023.102365

Parker, S. A., Weygand, J., Bernat, B. G., et al. (2024). Assessing radiology and radiation therapy needs for cancer care in low-and-middle-income countries. Advances in Radiation Oncology, 9. https://doi.org/10.1016/j.adro.2024.101615

Pramesh, C., Badwe, R., Bhoo-Pathy, N., et al. (2022). Priorities for cancer research in low- and middle-income countries: a global perspective. Nature Medicine, 28, 649–657.

Quinto, L., & Atento, R. G. (2025). Economic growth and developmental equity in four ASEAN economies: Linking macroeconomic trends to employment and child nutrition (1999–2024). International Journal of Health & Business Analytics, 1(1). https://doi.org/10.65166/nq75nv94

Salama, D. H., Allen, B., Frija, G., et al. (2026). From struggle to strength: transforming breast cancer screening for women in low- and middle-income countries. The British Journal of Radiology, 99, 603–608.

Shafi, S., & Parwani, A. V. (2023). Artificial intelligence in diagnostic pathology. Diagnostic Pathology, 18. https://doi.org/10.1186/s13000-023-01375-z

Subedi, R., Houssami, N., Nickson, C., et al. (2024). Factors influencing the time to diagnosis and treatment of breast cancer among women in LMICs: a systematic review. The Breast, 75. https://doi.org/10.1016/j.breast.2024.103714

Taib, N. M. A., Satar, N. A. F., Ali, A., et al. (2025). Multidisciplinary implementation of neoadjuvant therapy for early breast cancer in a middle-income country: real-world challenges in Malaysia. Asia-Pacific Journal of Clinical Oncology, 22, 111–99.

Trapani, D., Ginsburg, O., Fadelu, T. A., et al. (2022). Global challenges and policy solutions in breast cancer control. Cancer Treatment Reviews, 104, 102339.

Trapani, D., Murthy, S., Hammad, N., et al. (2024). Policy strategies for capacity building and scale up of the workforce for comprehensive cancer care: a systematic review. ESMO Open, 9. https://doi.org/10.1016/j.esmoop.2024.102946

Trapani, D., Murthy, S. S., Boniol, M., et al. (2021). Distribution of the workforce involved in cancer care: a systematic review. ESMO Open, 6. https://doi.org/10.1016/j.esmoop.2021.100292

Wee, H., Canfell, K., Chiu, H., et al. (2024). Cancer screening programs in South-east Asia and Western Pacific. BMC Health Services Research, 24. https://doi.org/10.1186/s12913-023-10327-8

Wilkinson, L., & Gathani, T. (2021). Understanding breast cancer as a global health concern. The British Journal of Radiology, 95. https://doi.org/10.1259/bjr.20211033

Yang, J., Dung, N., Thach, P., et al. (2023). Generalizability assessment of AI models across hospitals in a low-middle and high income country. Nature Communications, 15. https://doi.org/10.1038/s41467-024-52618-6

Youlden, D., Cramb, S., Yip, C., & Baade, P. (2014). Incidence and mortality of female breast cancer in the Asia-Pacific region. Cancer Biology & Medicine, 11, 101–115.

Verduzco-Aguirre, H., Favorito, F., De Moraes, Y. F., et al. (2025). Twenty years of breast cancer epidemiology and treatment patterns in Sao Paulo, Brazil. Lancet Regional Health — Americas, 47. https://doi.org/10.1016/j.lana.2025.101115