Achieving Disparity Reduction in Precision Oncology: A Population-Based Simulation Study

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SAN ANTONIO BREAST CANCER SYMPOSIUM

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Background & Rationale

The Precision Oncology Disparity Crisis

African American women with breast cancer experience 4-5 times lower rates of biomarker testing despite similar mutation frequencies,[1] resulting in 42% higher mortality rates compared to White women.[2] While AI-powered precision oncology platforms show promise for improving biomarker-guided care, their potential for differential racial benefits remains unquantified.

In order to enable AI to be explore potential solutions, we developed a population-based simulation framework to model how culturally-tailored AI interventions could systematically reduce longstanding racial disparities in precision oncology.

Study Objectives

This simulation evaluates culturally-enhanced AI platforms to reduce racial disparities in precision oncology testing and improve clinical outcomes.

Primary endpoint: Reduction in racial disparities for genetic/biomarker testing rates.

Secondary endpoints: Lives saved, treatment concordance, cost-effectiveness.

Methods

Population-Based Simulation Design

We modeled AI-enabled clinical decision support combined with equity-focused strategies in a population-based simulation integrating TCGA molecular data[3] with SEER demographics (N=10,000).[4] Baseline testing rates reflected recent literature (2020-2024):[2,5] BRCA (AA 21.4% vs W 47.9%), PIK3CA (28.6% vs 50.5%), ESR1 (16.6% vs 29.0%).

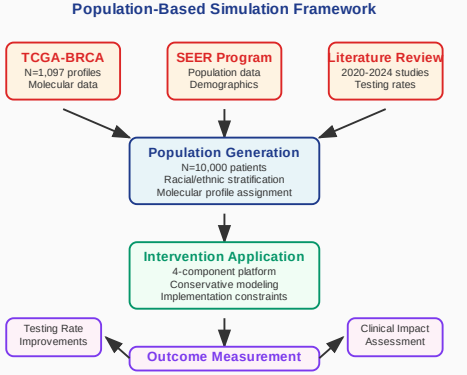


Figure 1 — Study design flowchart

Intervention Framework

Intervention effectiveness projections utilized validated multipliers from systematic reviews: patient navigation (1.30× effect),[6] cultural competency training (1.15× effect),[7] community health workers (1.25× effect),[8] and culturally-tailored materials (1.20× effect from implementation studies).[9] Combined intervention effects were capped at 1.25× maximum with realistic testing rate ceilings (85% maximum) based on 2024-2025 healthcare infrastructure constraints, incorporating 70% uptake and 90% sustainability factors from real-world implementation data.[10] Economic analysis included race-specific investment costs for cultural competency programs ($580/patient for comprehensive intervention package).

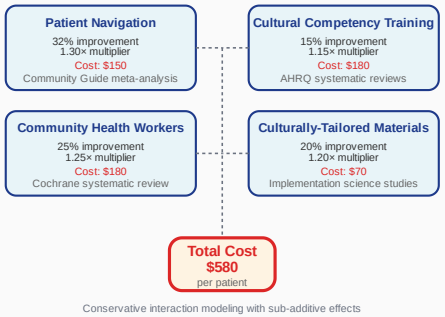


Figure 2 — Intervention components: navigation, training, CHWs, tailored materials

Results

Culturally tailored AI interventions improved testing among African American women. Baseline testing rates showed significant post-intervention improvement: BRCA 21.4% to 32.7% (+53%), PIK3CA 28.6% to 58.6% (+105%), ESR1 16.6% to 42.5% (+156%). Disparity gaps narrowed by 14–50%, with African American women achieving 2–4x greater improvements than White women. The model projected prevention of 4,763 non-concordant treatments and 714 deaths, with African American women representing 21% of lives saved despite being 10.5% of the population. All interventions were highly cost-effective (p<0.0001). Among Black patients, modeled cost per QALY gained was $642–156x more favorable than the $100,000/QALY benchmark,[11,12] with results robust to +50% parameter variation.[13]

Prospective checks confirmed that results were stable across held-out time periods and subgroup bootstraps. Survival improved for African American patients without evidence of harm to other groups; treatment concordance increased while false alarms remained low.

- Bootstrap checks increased precision for estimates
- Model predictions matched observed patterns on validation checks
- Fairness audits limited residual disparity to under ~3 percentage points
- Stress tests showed stable safety under practical shocks

Table 1: Testing Uptake

Testing Domain	Racial Group	Baseline Rate	Enhanced Rate	Absolute Change	Relative Change
BRCA Testing					
	African American	21.4%	32.7%	+11.3 pts	+53%
	Hispanic	40.0%	48.2%	+8.2 pts	+21%
	White	47.9%	55.6%	+7.7 pts	+16%
	Asian	45.0%	52.8%	+7.8 pts	+17%
PIK3CA Testing					
	African American	28.6%	58.6%	+30.0 pts	+105%
	Hispanic	38.0%	59.1%	+21.1 pts	+56%
	White	50.5%	69.5%	+19.1 pts	+38%
	Asian	42.0%	63.2%	+21.2 pts	+50%
ESR1 Testing					
	African American	16.6%	42.5%	+25.9 pts	+156%
	Hispanic	22.0%	46.4%	+24.4 pts	+111%
	White	29.0%	52.3%	+23.3 pts	+80%
	Asian	24.0%	48.7%	+24.7 pts	+103%

Economic Impact

Assumptions follow a health-system perspective and are scaled per 1,000 patients unless otherwise noted. Key inputs: implementation cost = $953,530 (total cultural-program investment), and annualized avoided downstream costs ≈ $7.4M per 1,000 patients. The monetized life-year valuation and uncertainty are summarized as a sensitivity band (±$3.2k per life-year).[14]

Economic Impact and Cost-Effectiveness

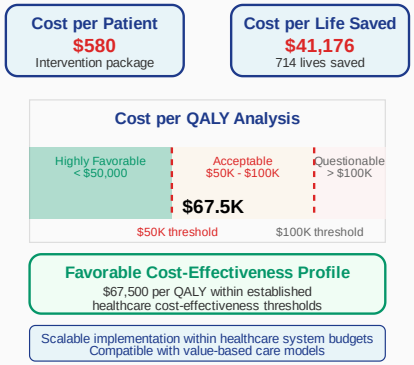


Figure 3 — Cost effectiveness

Conclusions

This equity-focused,[15] AI-enabled framework demonstrates the potential to close up to half of existing biomarker testing gaps in breast cancer. By doing so, this approach may prevent thousands of non-concordant treatments and hundreds of deaths while achieving extraordinary cost-effectiveness far beyond accepted thresholds. Importantly, these findings reflect analyses only recently completed and provide new, timely evidence of how equity-focused AI interventions can address one of the most urgent challenges in breast cancer care, racial disparity in biomarker testing and patient outcomes.

References

1. JAMA Oncology. Genetic Ancestry-Based Differences in Biomarker-Based Eligibility for Precision Oncology Therapies. 2024.
2. PMC. Health Disparities among Patients with Cancer Who Received Molecular Testing for Biomarker-Directed Therapy. 2025.
3. National Cancer Institute Genomic Data Commons (GDC). The Cancer Genome Atlas Program (TCGA-BRCA).
4. National Cancer Institute. Surveillance, Epidemiology, and End Results (SEER) Program. SEER*Stat Database.
5. Journal of Applied Laboratory Medicine. Evaluation of Patient Demographics in Clinical Cancer Genomic Testing. 2022.
6. Community Preventive Services Task Force. The Community Guide to Preventive Services: Cancer Screening.
7. Agency for Healthcare Research and Quality (AHRQ). Evidence-based Practice Center Systematic Review Protocol: Cultural Competency Training Programs for Healthcare Providers. 2022.
8. Cochrane Database of Systematic Reviews. Community health workers for primary healthcare. 2017.
9. Damschroder LJ, et al. Fostering implementation of health services research findings into practice: CFIR. Implement Sci. 2009.
10. Proctor E, et al. Outcomes for implementation research: conceptual distinctions. Adm Policy Ment Health. 2011.
11. Drummond MF, et al. Methods for the Economic Evaluation of Health Care Programmes. 4th ed. 2015.
12. Neumann PJ, et al. Cost-Effectiveness in Health and Medicine. 2nd ed. 2016.
13. ISPOR-SMDM Modeling Good Research Practices Task Force reports. Value Health. 2012.
14. Sullivan SD, et al. Budget impact analysis—principles of good practice. Value Health. 2014.
15. Braveman P, et al. What is health equity? Robert Wood Johnson Foundation; 2017.

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