



REVIEW ARTICLE

Modeling the economic equity of precision oncology

Ioanna Tsatsou ^{1*}, Stavros Fragkopoulos ²

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Abstract: Precision oncology promises improved outcomes by tailoring treatments to individual tumor profiles. Yet access to genomic testing and targeted therapies remains uneven across socioeconomic groups, raising concerns about equity. This conceptual paper presents an economic framework, utilizing a stylized model and hypothetical illustrations, to demonstrate how unequal access impacts both cost-effectiveness and distributional outcomes in precision oncology. Rather than an empirical study, this work serves as an analytical foundation and review of evidence that show that even when precision oncology is cost-effective overall, disparities in uptake can exacerbate health inequities. Policy interventions that improve equitable access may thus increase both efficiency and fairness in cancer care. Theoretical models, empirical illustration, and policy implications are presented to provide a comprehensive perspective on how health economics can incorporate distributional concerns in the era of precision medicine.

KEYWORDS: Precision oncology; equity; access; health economics

INTRODUCTION

The global cancer burden continues to grow, with an estimated 20 million new cancer cases and over 10.3 million deaths reported worldwide in 2025. This rising incidence is driven by population aging, growth, and increased exposure to risk factors such as tobacco, alcohol, and obesity, presenting significant challenges for cancer prevention and treatment globally (American Association of Cancer Research, 2025). Disparities in cancer care are pervasive globally, with low-income countries and underserved populations facing significant barriers in access to early diagnosis, effective and novel treatments, as well as to specialized healthcare professionals. These inequalities result in higher cancer mortality rates in these groups, underscoring the urgent need for equitable healthcare infrastructure and affordable cancer therapies worldwide (Tfayli et al., 2025)

Over the past two decades, precision oncology, defined as the tailoring of cancer therapies to the genetic and molecular profile of tumors, has emerged as a transformative approach. Precision oncology emphasizes

treatments that are directed by genetic information and are not limited by histological classification. These treatments are tailored to each patient based on biomarker analysis and include immunotherapy options such as adoptive cell therapy. By using biomarkers, genomic testing, and targeted therapies, clinicians can achieve significant gains in survival and quality of life for selected patients (Tsimberidou et al., 2020).

Nevertheless, a critical empirical problem persists as access to these genomic technologies and targeted therapies remains profoundly uneven across socioeconomic groups, with disadvantaged populations facing significant barriers including limited testing availability, financial constraints, and lack of specialized care. Consequently, while precision medicine offers clinical gains, it simultaneously risks widening the gap in health disparities (Francisco et al., 2025).

The economic literature has already established that many precision oncology interventions can be either cost-effective or even cost-saving when compared to standard care, particularly when considering long-term outcomes and targeted treatment efficiencies (Kasztura et al., 2019; Bourke et al., 2025). Several recent studies highlight that advances in genomic technologies and multi-omics platforms are increasingly reducing costs, making precision medicine more financially sustainable (Henkel et al., 2025), especially in high-risk and complex cancers such as pediatric (Owens et al., 2024) and chronic lymphocytic leukemia (Punian et al., 2025). Given that targeted treatments often lead to improved survival rates (Mapendano et al., 2025) and reduced adverse effects (Jallah et al., 2023), their cost-effectiveness is supported by assessments demonstrating favorable incremental cost-effectiveness ratios within accepted thresholds, although data still vary depending on cancer types, testing strategies,

^{1*} Nursing Department, University of West Attica, Agiou Spiridonos 28 street, Egaleo 12243, Greece.

² 401 General Army Hospital of Athens, Panagiotis Kanellopoulos Ave., Athens 115 25, Athens, Greece

**) corresponding author*

Ioanna Tsatsou

Nursing Department, University of West Attica, Agiou Spiridonos 28 street, Egaleo 12243, Greece
Email: itsatsou@uniwa.gr

and healthcare settings (Haslem et al., 2018). Thus, the existing evidence underscores the economic viability of precision oncology, which can potentially deliver better health outcomes at manageable costs for healthcare systems.

However, a major limitation of much of the current cost-effectiveness literature is its focus on averages. Conventional economic evaluations have often failed to address these disparities because they primarily focus on averages. Evaluations often calculate incremental cost-effectiveness ratios (ICERs) for populations as a whole, ignoring how benefits and costs are distributed across different socioeconomic strata. By treating populations as homogenous, these evaluations ignore the reality that health gains are often disproportionately captured by advantaged groups, even when an intervention appears cost-effective at an aggregate level. For instance, a study by Jayasundara et al. (2017) examined the differences in ICERs for drugs treating common versus rare cancers and found no significant statistical difference between the two groups, suggesting similar economic value across cancer types. Additionally, a systematic review by AlDoughaim et al. (2024) noted that while many targeted therapies tend to have favorable ICERs within accepted thresholds, the actual ratios vary depending on cancer type, testing strategy, and healthcare system, highlighting the importance of context-specific evaluations. These findings support the notion that targeted treatments can be cost-effective across different cancers, though the economic assessment remains nuanced and contingent on specific factors.

In practice, access to precision oncology is rarely universal. Patients in higher-income groups, urban settings, or countries with robust reimbursement systems are more likely to receive genomic testing and access advanced therapies (Gardner et al., 2021). Meanwhile, disadvantaged populations often face barriers such as limited availability of testing facilities, lack of insurance coverage, lower health literacy, and logistical barriers to treatment adherence (Adeniji, Dulal & Martin, 2021).

Current methodologies, which rely primarily on aggregate economic evaluations, often obscure the social cost of inequity by failing to explicitly model pervasive real-world access disparities. This leaves decision-makers with an incomplete picture that may mask the fact that health gains are disproportionately captured by advantaged groups, ultimately leading to an underestimation of the benefits of equitable resource allocation (Basnayake Ralalage et al., 2024). This paper addresses this significant theoretical gap by presenting a stylized economic framework designed to evaluate the intersection of efficiency and equity. Within this analysis, we define "economic equity" not merely as equal access, but as the intentional alignment of health policy to ensure that the benefits of genomic medicine are distributed fairly across all socioeconomic groups, rather than concentrated among the advantaged.

To explore the intersection of precision oncology and health equity, this manuscript uses a conceptual approach. By developing a stylized economic model and utilizing hypothetical scenarios, we examine the theoretical implications of differential access on population-level cost-effectiveness. This approach allows for the isolation of equity-efficiency trade-offs that are often masked in aggregated empirical data, providing a framework that policymakers can use to test the social value of equitable interventions. This paper expands the economic framework that considers both efficiency and equity. A stylized model of differential access is presented that illustrates its implications with hypothetical scenarios, and review real-

world examples. Our aim is not only to demonstrate that inequities exist, but also to show that improving equity can enhance overall cost-effectiveness and thus align fairness with efficiency.

CONCEPTUAL FRAMEWORK

The following framework is a stylized model designed to illustrate the economic implications of differential access. This model is not intended to provide empirical estimates for a specific healthcare system, but rather to serve as a pedagogical and policy-analysis tool to highlight how varying access probabilities (p_A , p_D) and incremental health gains (ΔQ_A , ΔQ_D) interact within the calculation of an Incremental Cost-Effectiveness Ratio (ICER).

The starting point of our model is a population divided into two groups: advantaged (A) and disadvantaged (D). Both groups experience a cancer burden that could potentially be alleviated by precision oncology. However, access probabilities differ substantially. Let the following parameters define the situation:

- p_A , p_D (Probability of Access): These probabilities represent the cumulative likelihood of a patient in each respective group successfully receiving the precision oncology intervention.
- ΔQ_A (ΔQ_A), ΔQ_D (ΔQ_D): (Incremental Health Gains): These variables represent the individual-level incremental quality-adjusted life years (QALYs) gained by a patient in the advantaged (A) or disadvantaged (D) group, respectively, who receives the precision intervention relative to the standard of care. These gains are conditional on treatment initiation.
- C: Incremental Cost per Patient: This represents the incremental cost of providing the precision oncology intervention (including genomic testing and subsequent targeted therapy) compared to the standard of care, calculated per patient who initiates treatment.

It is important to clarify that p is a stylized summary variable. In actual clinical practice, access is a complex, multi-stage process involving clinical suspicion, successful referral, completion of biomarker testing, and the ultimate initiation of targeted therapy. While our model treats this as a single probability for analytical clarity, it effectively functions as a proxy for the entire access channel, capturing the aggregate impact of all barriers (e.g., infrastructure, financial, or workforce-related) that may prevent a patient from ultimately receiving the precision therapy. The ICER for the entire population is given by:

$$ICER = C / (p_A \cdot \Delta Q_A + p_D \cdot \Delta Q_D)$$

This formula illustrates that ICERs are a function of both health gains and probabilities of access. It illustrates that if access probability p_D in the disadvantaged group is much lower than p_A , total incremental QALYs and thus the ICER will reflect primarily the advantaged group's outcomes. So, total health gains are disproportionately driven by the advantaged group, even if the intervention appears cost-effective overall. If equity is ignored, decision-makers may underestimate the social cost of unequal access.

To address the limitations of simplified modeling, it is essential to clarify the parameters of our analysis. In this stylized model, the incremental health gains for each group; ΔQ_A for the advantaged and ΔQ_D for the disadvantaged; are defined as the potential QALYs gained

from successful treatment. Importantly, we assume these gains are influenced by both the efficacy of the treatment and the patient's clinical context. Consequently, ΔQ_D may be lower than ΔQ_A not only due to limited access but also due to disparities in health literacy, higher prevalence of comorbidities, or later-stage disease at diagnosis.

Furthermore, while the model utilizes p_A and p_D as single probabilities, we acknowledge that 'access' to precision oncology is a multi-stage channel. This journey encompasses several critical points; clinical suspicion, referral for genomic testing, successful completion of biomarker analysis, and the initiation of targeted therapy.

Each stage in this channel; from initial diagnosis to the delivery of personalized therapy, presents unique barriers, particularly for underserved populations who may face systemic challenges related to infrastructure, workforce shortages, and insurance coverage. In the model, p_A and p_D represent the cumulative probability of successfully navigating this entire pipeline. By isolating these probabilities, we allow for a focused economic evaluation of how systemic barriers—regardless of which stage they occur—impact the overall cost-effectiveness and equity of cancer care interventions.

Extending the framework with inequality weights

The application of inequality weights in DCEA is not merely a technical exercise in model adjustment; it represents a deliberate, normative value judgment grounded in principles of social justice and utilitarianism. By assigning higher weights to health gains achieved by disadvantaged groups, a society explicitly affirms that reducing health disparities is a priority. It is important to emphasize that the specific weights applied in the illustrative example are hypothetical; they are not empirically established constants, but rather serve as illustrative policy levers used to visualize how a decision-maker might quantify the social value of equitable health outcomes. These scenarios provide a framework for testing the impact of different policy preferences on the overall ICER, rather than providing fixed, universal parameters for clinical decision-making.

Our selection of an equity-weighted ICER, rather than a DCEA or a net-benefit framework, is driven by the need for a pragmatic and accessible policy tool. While a full DCEA provides a comprehensive quantification of health equity trade-offs, it typically demands substantial empirical data regarding the health opportunity cost of displacement within a specific healthcare system. In contrast, the equity-weighted ICER preserves the intuitive, familiar structure of standard cost-effectiveness benchmarks while explicitly incorporating social preferences for equity. This approach serves as a vital bridge between standard health technology assessment and equity-sensitive resource allocation, allowing decision-makers to test the implications of prioritizing disadvantaged groups without the prohibitive complexity of a full DCEA.

Building on these principles, we can introduce inequality weights to reflect the social value of quality-adjusted life year (QALY) gains for disadvantaged groups. Let w_A and w_D denote weights (with $w_D > w_A$) reflecting societal preferences for reducing health disparities. The equity-weighted ICER becomes:

$$ICER_{equity} = C / (w_A \cdot p_A \cdot \Delta Q_A + w_D \cdot p_D \cdot \Delta Q_D)$$

This extension shows that enhancing access for disadvantaged groups may yield disproportionately higher social value when equity considerations are included.

Because the assignment of inequality weights is a normative value judgment, it is essential to consider how variations in these weights influence the ICER. In this sensitivity analysis, we evaluate three scenarios to demonstrate the impact of different levels of social priority assigned to the disadvantaged group (w_D), while holding the advantaged group weight (w_A) constant at 1.0. In a neutral scenario where w_D is 1.0, the ICER remains \$37,037 per QALY, reflecting no explicit equity adjustment. If the social priority is increased to a moderate level ($w_D = 1.5$), the equity-weighted ICER improves to \$34,482 per QALY. Under a strong priority scenario ($w_D = 2.0$), the ICER further improves to \$32,467 per QALY. This sensitivity analysis demonstrates that the choice of weight is a critical policy lever: by explicitly debating and assigning these weights, stakeholders can formalize their society's commitment to reducing health disparities and determine the extent to which they are willing to prioritize equity in resource allocation.

Illustrative example

To demonstrate the economic implications of our framework, we apply hypothetical parameters typical of precision oncology evaluations. The incremental cost of the precision oncology intervention is set at \$50,000, representing typical costs for advanced diagnostic and therapeutic combinations (Owens et al, 2024). We assume individual-level incremental QALY gains of 1.5 for the advantaged group (ΔQ_A) and 1.2 for the disadvantaged group (ΔQ_D). These gains are calibrated to reflect the potential for favorable health outcomes documented in systematic reviews, with the lower QALY value for the disadvantaged group acknowledging clinical disparities, such as higher prevalence of comorbidities or later-stage disease at diagnosis.

Baseline Scenario: With an access probability (p) of 0.8 for the advantaged group and 0.2 for the disadvantaged group, the weighted incremental QALYs gained are $(0.8 \times 1.5) + (0.2 \times 1.2) = 1.44$. The ICER is calculated as:

$$ICER = 50,000 / 1.44 = 34,722 \text{ USD per QALY}$$

This ICER is below a common willingness-to-pay threshold of \$50,000 per QALY, indicating that the intervention is cost-effective overall. However, 83% of the total health gains ($1.2 / 1.44$) primarily benefit the disadvantaged group.

Equity Intervention Scenario: If policy interventions increase access for the disadvantaged group to 0.6, the weighted incremental QALYs gained become $(0.8 \times 1.5) + (0.6 \times 1.2) = 1.92$. The ICER is recalculated as:

$$ICER = 50,000 / 1.92 = 26,042 \text{ USD per QALY}$$

In this scenario, health benefits are more equitably distributed, and the intervention becomes significantly more cost-effective. By improving access for the disadvantaged group, the intervention not only reduces health disparities but also enhances the overall social value of the precision oncology program.

Introducing equity weights that assign twice the social value to QALYs gained by the disadvantaged group (weight 2 vs. 1 for advantaged) further improves the ICER, reflecting society's preference for reducing disparities. This example highlights how improving access and applying equity

weights can enhance both cost-effectiveness and social value in precision oncology.

For precision oncology, such population-level ICER calculations are consistent with cost-effectiveness literature examples (Christofyllakis et al., 2022) although exact numeric values depend on specific inputs and assumptions.

It is important to state that the numerical parameters selected for this illustration are based on ranges commonly observed in precision oncology economic evaluations. The incremental cost of \$50,000 is chosen to reflect typical costs for advanced diagnostic and therapeutic combinations. The QALY gains (1.5 for the advantaged group; 1.2 for the disadvantaged group) are calibrated to reflect the potential for favorable health outcomes documented in systematic

reviews of targeted therapies. The slight reduction in QALYs for the disadvantaged group (1.2 vs 1.5) acknowledges the potential for disparities in clinical outcomes due to factors such as later-stage diagnosis at presentation or differences in supportive care. The access probabilities (0.8 for advantaged; 0.2 for disadvantaged) represent a conservative baseline scenario of high inequality, which allows for a clear demonstration of the policy impact when access is improved to 0.6.

The following table presents the example. With increasing access in the disadvantaged group increases overall QALYs gained and reduces the ICER, while the share of health gains shifts towards more equity.

Table 1. Hypothetical ICER Scenarios under Different Access Probabilities

Scenario	Access Rate Advantaged (p _A)	Access Rate Disadvantaged (p _D)	Total QALYs Gained	ICER (\$/QALY)	Share of QALYs to Advantaged
Baseline	0.8	0.2	1.44	\$34,722	83%
Equity Intervention	0.8	0.6	1.92	\$26,042	63%

Note: The model assumes a fixed incremental cost of \$50,000. QALY gains are $\Delta Q_A = 1.5$ and $\Delta Q_D = 1.2$. The 'Share of QALYs to Advantaged' is calculated as $(p_A \cdot \Delta Q_A) / (p_A \cdot \Delta Q_A + p_D \cdot \Delta Q_D)$, illustrating how the distribution of health benefits shifts as access for the disadvantaged group increases. A decrease in this percentage indicates a more equitable distribution of the therapeutic benefits.

DISCUSSION

Real-world evidence supports this stylized example provided. For instance, studies show that uptake of next-generation sequencing is higher among insured and urban patients compared to uninsured and rural ones (Marquart et al., 2018; Zhao et al., 2024). In Europe, reimbursement policies for biomarker tests vary significantly, with wealthier countries offering broader coverage. In low- and middle-income countries, access to precision oncology is often limited to elite hospitals (Normanno et al., 2023). These disparities suggest that without deliberate policy action, precision oncology could widen health gaps even as it improves outcomes for some (Lakdawalla & Malani, 2015).

Health equity considerations are crucial for socially responsible decision-making in precision oncology (Peebles, Kinney & Foster-Hanson, 2024). The economic model described, dividing a population into advantaged (A) and disadvantaged (D) groups with differing access probabilities (p_A and p_D) to precision oncology interventions and varying incremental QALYs (ΔQ_A and ΔQ_D), reflects concerns highlighted in the literature on disparities in access to precision oncology (Esdaille et al., 2022; Cheung et al., 2023; Barragan-Carillo et al., 2025). This framework captures how differences in access can skew health gains predominantly toward advantaged groups, potentially underestimating the social cost of inequity if overall cost-effectiveness (ICER) is assessed without equity considerations.

Recent analyses emphasize that unequal access to genomic testing and targeted therapies contributes to widening health disparities. Dowell et al. (2023) discuss how socioeconomic and racial/ethnic disparities affect incidence, treatment access, and outcomes in cancer care, noting that limited access to precision oncology in disadvantaged populations reduces overall population health gains despite apparent cost-effectiveness. Similarly, studies highlight that economic evaluations in precision oncology must incorporate equity-sensitive parameters to avoid masking the disproportionate benefits accruing only

to advantaged groups (Saulsberry & Olopade, 2021; Dawkins et al., 2024)

The concept of incorporating inequality weights within distributional cost-effectiveness analysis (DCEA) to reflect societal value for QALYs gained by disadvantaged groups is supported by the economic literature (Cookson et al., 2020; Meunier et al., 2023; Shafrin et al., 2024). DCEA explicitly quantifies equity-efficiency trade-offs by modelling how health gains and costs are distributed across social groups and applying weights to emphasize reductions in health disparities (Francis et al., 2025). Smith et al. (2025) provide a framework for applying DCEA in genomic medicine, emphasizing the importance of capturing variations in intervention effects and access across populations while incorporating equity weights into cost-effectiveness ratios. This approach allows decision-makers to better consider social preferences for equity rather than only average health gains, preventing underestimation of the social cost of unequal access. The proposed formula of this paper aligns with best practices in health economics for integrating equity explicitly into resource allocation decisions.

Our analysis contributes to a critical shift in the field of health technology assessment (HTA). Historically, economic evaluations of precision oncology have relied on population-level ICERs, which focus on average outcomes (Love-Koh et al., 2018). As our framework demonstrates, this aggregate focus is inherently limited; it risks masking distributional inequities and may inadvertently favor interventions that primarily yield benefits for already advantaged populations.

By contrast, our model aligns with the paradigm of DCEA, which explicitly incorporates social value and equity-efficiency trade-offs into the resource allocation process. Our study illustrates that cost-effectiveness is not an absolute, static figure, but rather a variable dependent on the social distribution of access. By demonstrating that improving equity can enhance overall cost-effectiveness, we provide a conceptual argument for why health systems

should move beyond average ICERs and toward assessment frameworks that capture the social cost of inequality.

The whole analysis demonstrates that precision oncology raises complex questions at the intersection of efficiency and equity. While conventional ICERs provide useful benchmarks, they may mask distributional inequities. Incorporating equity weights and scenario analyses can yield richer insights. Importantly, enhancing access for disadvantaged groups is not only ethically desirable but also economically rational when broader social value is considered.

Moreover, cancer care systems must anticipate that the costs of precision oncology will continue to evolve. As genomic sequencing becomes cheaper, the main barriers may shift from testing costs to therapy affordability and infrastructure availability (Barrios et al., 2023). Anticipating these shifts requires dynamic economic modeling.

Limitations

While this conceptual framework provides a robust tool for visualizing the interaction between equity and efficiency, several limitations should be acknowledged. First, this is a stylized, theoretical model rather than an empirical analysis; therefore, the numerical outcomes are illustrative and intended to demonstrate the mechanism of inequality rather than to predict specific real-world results.

Second, our representation of access as a single probability (p_A , p_D) is a simplification of a complex, multi-stage healthcare delivery pipeline. In clinical practice, access to precision oncology is influenced by numerous factors beyond a single probability, including clinical suspicion, referral pathways, workforce shortages, and diagnostic accuracy. Consequently, the barriers preventing a patient from receiving targeted therapy are not uniform and fluctuate significantly between rural and urban areas or across national borders.

Third, the direct transferability of these findings across diverse health systems is subject to significant limitation, as the validity of our parameters is inherently contingent on the specific cancer type, testing strategy, and local healthcare setting. Financial barriers, for example, differ based on whether a system relies on public insurance, private coverage, or extensive out-of-pocket expenditures. Because risk-pooling mechanisms and the availability of subsidies are context-specific, a model calibrated for a country with universal healthcare coverage cannot be directly transplanted to a setting where out-of-pocket costs drive catastrophic financial hardship. For instance, in low- and middle-income countries, access may be restricted to elite hospitals, whereas in high-income settings, the primary barriers may relate to pre-authorization or specific infrastructure gaps.

Ultimately, these findings should be viewed as a flexible framework for policy analysis rather than a set of fixed, universal parameters. Future empirical research is required to parameterize these models for specific health systems and patient populations, with particular attention to settings where the stakes for equitable access are highest.

Policy implications

The economic implications of unequal access are multifaceted. First, cost-effectiveness analyses that ignore equity may inadvertently favor interventions that benefit already advantaged populations (Yerramilli, Chopra, & Rasanathan, 2024). Second, policies that broaden access through subsidies, insurance coverage, or targeted outreach, can improve both efficiency and fairness (Cookson

et al., 2017). Third, integrating distributional considerations into health technology assessment (HTA) frameworks is essential for aligning innovation with social justice (Pacífico Silva et al., 2018).

Financing and insurance

Insurance coverage for genomic testing critically influences equitable access to precision oncology. In the United States, Medicare covers several genomic tests, primarily when medically necessary, though private insurer policies vary widely and often require pre-authorization based on clinical criteria. Many insurers are more likely to cover single-gene or limited-panel tests compared to comprehensive whole-exome or genome sequencing, and out-of-pocket costs still apply for many patients even when partially covered. In low- and middle-income countries, genomic testing and targeted therapies often remain unaffordable, resulting in out-of-pocket expenditures that can lead to catastrophic financial hardship for households (Phillips et al., 2022; Yabroff et al., 2024).

To address these inequities, risk-pooling mechanisms such as expanded public insurance programs or donor-funded subsidies are essential for alleviating financial barriers and improving access globally. These strategies align with policy recommendations for expanding reimbursement frameworks and reducing disparities in genomic medicine access (Ringborg et al., 2024).

Financing mechanisms must be decoupled to specifically distinguish between the funding needs for diagnostics, therapeutic agents, and supportive care. For diagnostic testing, insurers should shift from pre-authorization-heavy models to standardized, universal coverage for evidence-based genomic panels, with operational success measured by the percentage of patients completing biomarker testing within 14 days of their initial consultation. For targeted therapies, governments in all settings should implement tiered pricing models and public insurance expansion to protect patients against catastrophic financial hardship, a metric evaluated by the ratio of patient out-of-pocket expenditures to total household income.

Financing frameworks must also explicitly allocate budget for non-clinical supportive services, such as genetic counseling, telemedicine, and patient navigation, which are vital for treatment adherence in underserved groups, with efficacy tracked by comparing adherence rates between disadvantaged and advantaged cohorts. In high-income contexts, policy priority should be placed on regulatory harmonization to eliminate the coverage lottery across private and public payers. Conversely, in low- and middle-income countries, the strategy must rely on donor-funded subsidies and pooled procurement to alleviate the catastrophic financial barriers that characterize these settings.

Infrastructure and workforce

Infrastructure and workforce strategies must be tailored to the specific capacity of each healthcare system. Rural and underserved populations often face significant barriers in accessing genomic testing due to limited availability of testing facilities and shortages of trained oncologists and healthcare professionals (Coughlin et al., 2019). Addressing these gaps in high-income settings requires prioritizing regulatory harmonization and the integration of genomic data into existing electronic health records to improve systemic efficiency. Also, targeted investments in healthcare infrastructure, including establishing regional testing centers and expanding telemedicine services, which can

deliver remote genetic counseling and diagnostics. Public-private partnerships play a pivotal role in scaling genomic testing capacity by combining resources, expertise, and technology from government bodies, industry, academia, and patient advocacy groups. These collaborations can accelerate research and innovation, facilitate the establishment of regulatory standards, and provide cost-effective infrastructure that would be challenging for individual entities to develop alone. By leveraging shared expertise and economies of scale, such partnerships enable faster integration of cutting-edge genomic technologies into clinical practice, ultimately improving equitable access to precision oncology, especially in resource-limited or geographically isolated areas (Granados Moreno, Joly, & Knoppers, 2017).

In low- and middle-income contexts, efforts must focus on public-private partnerships to scale genomic testing capacity through regional centers, thereby bypassing the need for every facility to develop independent, high-cost infrastructure. To measure the success of these infrastructure investments, health systems should track the reduction in time-to-treatment initiation for disadvantaged populations compared to the national average. Furthermore, the expansion of telemedicine services should be a universal priority to mitigate workforce shortages, allowing remote access to genetic counseling and diagnostic expertise regardless of the patient's geographic location (Radich et al., 2022).

Ethical and regulatory considerations

Ethical and regulatory considerations surrounding genomic data and precision oncology underscore that equitable access is not only a matter of economics but an ethical imperative (Gerido & Ayday, 2024). Policies must ensure genomic data is handled responsibly, safeguarding patient privacy and preventing discrimination (Karabekmez, 2021). The inherent identifiability of genomic information poses unique privacy challenges, as re-identification risks can extend beyond individuals to their biological relatives, necessitating robust protections grounded in bioethical principles such as autonomy, beneficence, and equity (Martinez-Martin & Magnus, 2019).

Regulators should also promote mechanisms such as tiered pricing and compulsory licensing to enhance the affordability of targeted therapies, balancing innovation incentives with broader public health needs (Bognar, Bychkovsky, & Lopes, 2016). Ensuring transparent data governance and equitable distribution of benefits aligns with ethical standards in genomics research and clinical practice while fostering trust among patients and communities (Karabekmez, 2021).

CONCLUSION

Precision oncology is reshaping the economics of cancer care. While it holds promise for improving survival and quality of life, its benefits risk being unequally distributed. This analysis illustrates that inequities in access can distort both cost-effectiveness and fairness. By incorporating equity into economic evaluations and implementing policies that broaden access, societies can achieve both greater efficiency and justice. Future research should further explore empirical applications of equity-weighted cost-effectiveness, with special attention to low and middle income countries where the stakes are highest.

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We consent to the publication of this article and are prepared to offer any necessary support or additional information to facilitate the publication process

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The authors are equally responsible for all aspects of the research, including conceptualization, data curation, formal analysis, investigation, methodology, project administration, resources, software, supervision, validation, visualization, writing – original draft, and writing – review & edit.

ABOUT THE AUTHORS

Dr. Ioanna Tsatsou is an Academic Fellow at the Sector of Medical - Surgical Nursing of the Department of Nursing of the University of West Attica. She has served as an instructor in numerous undergraduate and postgraduate courses and continuing professional activities. Her research focuses on oncology nursing and palliative and supportive care of cancer patients.

Mr Stavros Fragkopoulou is a Major of the Hellenic Air Force and has been serving as a clinical nurse at the General Army Hospital of Athens since 2014. His clinical activity involves work in the Cardio-thoracic and Cardiology Intensive Care Unit of the hospital.

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Correspondence All inquiries and requests for additional materials should be directed to the Corresponding Author.

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