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The Missed Signal: Rethinking How We Detect Cancer and Chronic Disease

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Abstract

The detection of cancer and chronic disease is a challenge for contemporary medicine, with delays in diagnosis often contributing to morbidity and mortality. The traditional methods for the detection of cancer are often invasive, insensitive to the early stages of cancer and often only detect cancer in a subset of the population. This article examines emerging methods for the detection of cancer and chronic disease, focusing on technologies like liquid biopsy, circulating tumor DNA (ctDNA), multi-cancer early detection (MCED) tests and artificial intelligence-aided diagnostics. While current technologies have led to the discovery of biomarkers for early-stage cancer that was previously undetectable through conventional screening methods, challenges in the detection of low-abundance ctDNA, costs of the technologies, lack of validation of these technologies and the disparities in the access to these technologies limit their application. However, these technologies have the potential to revolutionize the detection of cancer and chronic disease and this paper proposes a new structure for the detection of cancer and chronic disease that addresses these challenges.

Keywords: cancer detection, liquid biopsy, circulating tumor DNA, multi-cancer early detection, diagnostic delay, health equity, biomarkers, artificial intelligence

1. Introduction

Cancer remains among the leading causes of death globally, with approximately 10 million deaths annually attributed to the disease (Sasieni et al., 2025). Despite advances in the treatment of cancer, the five-year survival rates for people with cancer vary significantly based on the stage of cancer: localized cancer has a five-year survival rate of over 90%, whereas metastatic cancer has a survival rate of less than 30% (Imai et al., 2025). The best intervention for reducing the mortality rate from cancer is early detection of the disease. However, current screening paradigms for cancer detect fewer than five of the cancer types, with a fraction of the cancers that exist in the general population (Chen et al., 2025). These screening programs are often organ-specific, such as mammography for breast cancer, colonoscopy for colorectal cancer, low-dose computed tomography for lung cancer in high-risk populations and prostate-specific antigen testing for prostate cancer (Sasieni et al., 2025). Although these screening programs have demonstrated reductions in mortality from the cancers for which they are performed, they only account for fewer than five types of cancer (Chen et al., 2025). Also, these screening programs have limitations, such as the invasiveness of the procedure, radiation exposure to the individual screened, the rate of false positives that result in unnecessary follow-up processes and the lack of compliance with the screening program by the people who are screened (Carbonell et al., 2024).

Liquid biopsy is defined as the use of materials from tumors found in body fluids. This is a new way of detecting cancer. With circulating tumor DNA, cell-free RNA, proteins, metabolites and other tumor markers in blood, liquid biopsy tools promise to find cancers early, track how well treatments work and spot tiny amounts of remaining disease with high sensitivity (Zeng et al., 2024). Multi-cancer early detection tests use machine learning to study complex marker patterns. These tests have become very promising for screening whole populations (Guerra et al., 2023). Moving these tools from research to real-world clinics faces big hurdles. This includes technical difficulties in finding rare markers, high costs, missing validation data, unclear rules from regulators and unequal access that could worsen existing health gaps. This paper looks closely at where cancer and chronic disease detection stand today and where it is heading. The analysis covers liquid biopsy tools, how well multi-cancer early detection tests perform, the use of artificial intelligence and fairness in who gets screened.

2. The Burden of Diagnostic Delay and Limitations of Current Screening Paradigms

2.1 Diagnostic Delay as a Systemic Failure

Diagnostic delay represents a complex problem that includes various patient-related, provider-related and system-related factors. Patient-related factors include differences in symptom recognition and help-seeking behavior, while provider-related factors involve disparities in clinical suspicion and referral practices. System-related factors encompass aspects such as healthcare access, resource availability and care coordination challenges. Evidence suggests that many diagnostic intervals span weeks to months, allowing the underlying disease to progress and potentially alter prognosis, per Tursunalievna et al. (2023). In cases of rapidly steady malignancies such as pancreatic cancer, delays of even a few weeks can render potentially resectable tumors non-resectable, effectively removing curative treatment options as reported by Jaworski et al. (2020). The consequences of diagnostic delay extend beyond individual patient outcomes, also implicating important economic and societal costs. Late-stage diagnoses necessitate more intensive treatments, increased caregiver burden and greater lost productivity. As highlighted by Tursunalievna (2023), the cost of time is high, with each month of diagnostic delay representing a measurable decrement in survival probability.

2.2 Structural Limitations of Single-Cancer Screening

The current screening programs have several basic limitations that reduce their impact on the population. The first limitation is that screening methods aimed at single organs are not very efficient because they require many separate tests to check for a small number of cancer types. The USPSTF now recommends screening for five cancer types only, so most new cancers are undetected (Vittone et al., 2024). The second limitation is that the screening methods do not detect early stage disease very well, even though detection of this disease would help people the most. For example, mammography detects about 85 percent of invasive breast cancers but detects very few cases of ductal carcinoma in situ and cases in women with dense breast tissue (Hanash et al., 2011). Another basic limitation is that the compliance is very low. Colonoscopy is the best test for colorectal cancer but it has low use rates because it is invasive, requires bowel preparation and requires sedation. Screening rates for colorectal cancer in the United States are below 70 percent and the rates are even lower for underserved groups (Hassan et al., 2025). These issues with compliance show the need for easier screening methods that patients will actually use.

2.3 The Screening Gap: Cancers Without Established Detection Methods

At present, screening paradigms have yet to effectively capture a wide range of lethal cancers. In particular, for Pancreatic cancer - a third leading cause of death in the United States despite making up only 3% of incident cancers, as noted by Chen et al. (2024) - more than 80% of patients diagnosed with this disease present at an advanced-stage with surgically resectable tumors; for such cancers, a Five-year survival rate is typically below 10%. The same trends are also seen for ovarian, gastric, esophageal and hepatocellular carcinoma, where population-level screening strategies remain elusive and late-stage diagnoses yield poor outcomes.

3. Liquid Biopsy Technologies: Biological Foundations and Technical Capabilities

3.1 Circulating Tumor DNA: Biology and Detection Principles

Circulating tumor DNA (ctDNA) is composed of DNA fragments that are released from cancer cells into the bloodstream through apoptosis, necrosis and active secretion from cancer cells. These cell-free DNA (cfDNA) fragments are typically 150-200 base pairs in length and contain genetic and epigenetic alterations that are specific to cancer cells (Bronkhorst et al., 2020). The percentage of cfDNA that is composed of ctDNA varies by cancer type and stage, with ctDNA often undetectable in early-stage cancer but making up over 50% of cfDNA in advanced metastatic cancer. Due to the low abundance of ctDNA in the bloodstream, analytical methods are required to detect ctDNA against the abundant normal cfDNA. Various technical approaches have been developed to detect ctDNA in the bloodstream. Targeted sequencing approaches are sensitive to specific genetic mutations associated with cancer but are limited in their ability to detect other genetic alterations. Whole-genome sequencing is more complete in its analysis of the cfDNA but requires sequencing of deep libraries to detect the genetic mutations present in ctDNA. Methylation-based approaches are able to detect epigenetic alterations that are specific to cancer cells and are more stable than genetic mutations (Li et al., 2024). Fragmentomics involves the analysis of the size distribution of cfDNA and the identification of fragmentation patterns that are specific to cancer cells (Nguyen et al., 2023).

3.2 Multimodal Biomarker Approaches

It has been understood that there is no biomarker type that can provide the best sensitivity and specificity. This realisation led to the development of multimodal methods based on the combination of different signals. This approach is illustrated by SPOT-MAS assay, which combines analysis of methylomics, fragmentomics, copy number alterations and end motifs in one workflow by shallow

genome-wide sequencing (Nguyen et al., 2023). SPOT-MAS assay showed a sensitivity of 72.4% and specificity of 97.0% for the detection of five common cancer types in 738 nonmetastatic cancer patients and 1, 550 healthy controls. Sensitivity for early-stage (stage I) cancer was 62.3%. Also, only 0.55X sequencing depth was sufficient, which, as a consequence, resulted in important cost reduction compared with high-depth sequencing methods. Other multimodal methods analysed combinations of different biomarker types in addition to DNA-based signals. Bratulic et al. (2022) demonstrated that plasma and urine glycosaminoglycan (GAG) profiles and metabolic biomarkers exceeded stage I sensitivity over 60% across 14 cancer types. These profiles are associated with tumour-associated changes in the extracellular matrix. The sensitivity of these profiles was approximately twice that of contemporary genomic biomarkers. Kisiel et al. (2024) supported the use of a 'multi-biomarker class approach' that combines DNA methylation, protein biomarkers and other analytes. The authors emphasised that this approach maximises detection sensitivity, while maintaining an acceptable level of specificity.

3.3 Technical Challenges and Analytical Validity

Although, technical progress has been impressive, there remain many analytical challenges in the implementation of liquid biopsy technologies in clinical practice. Detection of low levels of ctDNA in early stage cancers requires very sensitive tests with very low background noise. Techniques for blood collection, processing, storage and cfDNA extraction have a important impact on test performance (Bronkhorst et al., 2020). Clonal hematopoiesis of indeterminate potential (CHIP), an age-related accumulation of somatic mutations in hematopoietic cells, poses a important source of false positive signals, because CHIP cfDNA carries cancer-associated mutations but does not manifest cancer (Jamshidi et al., 2022). MCED test validation requires demonstrating accuracy, precision, reproducibility and robustness in diverse populations and clinical contexts. The absence of standard reference materials and quality control metrics poses a important challenge for comparative assessment of different MCED tests across different platforms or for regulatory evaluation of these tests. LeeVan et al. (2023) performed a systematic review of cell-free nucleic acid-based MCED tests and found important discrepancies in study designs, performance metrics and reporting standards that prevent the drawing of meaningful conclusions about the performance of different MCED tests.

4. Multi-Cancer Early Detection Tests: Performance and Clinical Utility

4.1 Sensitivity and Specificity Across Cancer Types and Stages

Multi-cancer early detection tests have demonstrated variable performance across cancer types, stages, and populations. Figure 1 summarizes the sensitivity and specificity characteristics of representative MCED tests based on recent validation studies.

Figure 1: Performance Characteristics of Selected Multi-Cancer Early Detection Tests

Test/Study	Technology Platform	Cancer Types	Overall Sensitivity	Stage I-II Sensitivity	Specificity	Sample Size
SPOT-MAS (Nguyen et al., 2023)	Methylation + fragmentomics	5 types	72.4%	62.3% (I), 73.9% (II)	97.0%	738 cases, 1,550 controls
GAGome (Bratulic et al., 2022)	Glycosaminoglycan profiling	14 types	~60% (stage I)	60% (stage I)	Not reported	Validation cohort
Galleri (Jamshidi et al., 2022)	Methylation-based	50+ types	51.5%	16.8% (I), 40.4% (II)	99.5%	2,823 cases, 1,254 controls
PanSeer (Chen et al., 2019)	Methylation markers	5 types	88% (1-4 years pre-diagnosis)	Variable by type	96%	Longitudinal cohort

The data reveal some consistent trends. For example, the sensitivity improves with clinical stage, likely due to increasing ctDNA abundance during disease progression. Similarly, while the sensitivity varies greatly across cancer types with high sensitivities in cancers releasing abundant ctDNA and poor sensitivities in cancers releasing limited amounts, specificity remains at or near the benchmark of 95%, minimizing false positives and so ensuring safe application for population screening. The anatomic site prediction for the tumor-of-origin also exhibits varying performances among different cancers with accuracy between 70-90%. (Nguyen et al., 2023)

4.2 Clinical Utility and Implementation Considerations

The clinical utility of a diagnostic test requires evidence that the test leads to an improvement in the outcomes of those people that receive the test. Clinical utility for MCED tests requires that the test can improve survival rates, quality of life or other important outcomes for people that receive the test. However, clinical utility data for MCED tests are limited. While case-control studies and retrospective analyses of MCED testing have been performed (Sasieni et al., 2025), the majority of these studies were not prospective studies with long follow-up periods. The PATHFINDER study is the first prospective study of MCED testing and screening. The study results for the PATHFINDER study revealed that the Galleri test detected cancer in 1.4% of those that received the test, with a 38% positive predictive value of cancer detection and a median of 79 days to determine the diagnosis of the cancer that was detected (Ebbert et al., 2025). These results show that MCED tests have the potential to improve the outcomes of those people that receive the test but also show that there are challenges to implementing MCED testing, including creating pathways to diagnose cancers that are detected with the Galleri test and managing indeterminate results.

4.3 Comparative Analysis: MCED Versus Conventional Screening

Another question is whether MCED tests should replace, complement or complement current screening tests. Vittone et al. (2024) examined how effective a MCED test was for cancers with no USPSTF-recommended screening. Their results found that MCED tests were 57% effective for detecting stage I-III cancers in this group. This suggests that MCED tests are more useful for cancers without screening than replacing effective current screening. Studies have attempted to estimate the cost-effectiveness of MCED screening but these analyses have limitations. Uncertainty surrounds test performance, the cost of diagnostic follow-up, the effectiveness of cancer treatments for screen-detected cancers and long-term outcomes. Carbonell et al. (2024) suggested that MCED tests might fill gaps in cancer screening by covering underscreened cancers and populations. They also suggested that cost-effectiveness depends on the test price, the sensitivity of the MCED test for early-stage disease and false positives.

5. Artificial Intelligence and Machine Learning in Cancer Detection

5.1 AI-Enabled Biomarker Discovery and Pattern Recognition

Artificial intelligence and machine learning have become basic in contemporary cancer diagnosis for analyzing large-scale, high-dimensional biomarker data beyond human comprehension. Deep learning algorithms have enabled researchers to uncover hidden patterns across methylation profiles, fragmentomics, imaging and other multi-omics data, which classify cancer versus non-cancer states with large accuracy (Monika et al., 2024). For instance, Nguyen et al. (2023) leveraged graph convolutional neural networks to predict tumor-of-origin with 70% accuracy by identifying multimodal features from cfDNA data. The adoption of machine learning approaches in cancer diagnostics offers numerous benefits, including the ability to integrate heterogeneous data (e.g., genomic, epigenomic, proteomic, metabolomic, clinical) into whole predictive frameworks, to detect subtle biomarker signatures possibly undetectable through traditional statistical methods and to iteratively refine performance as expanding datasets become available. Yet, AI-driven diagnostic tools also present challenges, such as model interpretability issues (the "black box" dilemma), natural risks of algorithmic biases when training datasets are not adequately representative and the propensity to overfit training samples leading to limited transferability across diverse patient cohorts (Zeng et al., 2024).

5.2 AI in Diagnostic Imaging and Pathology

Beyond liquid biopsy, deep learning has already revolutionized radiographic image interpretation, especially diagnostic imaging and digital pathology. In recent years, deep learning algorithms have achieved expert-level performance in detecting and diagnosing several abnormalities, including lung nodules from CT scans, breast lesions on mammograms and skin lesions in photos. In pathology, AI systems can analyze whole-slide images of cancers and identify malignant cells, diagnose tumors and even predict the molecular subtypes almost as well as human pathologists (Jiang, 2024). Combining AI-enabled imaging analysis with liquid biopsy data - as suggested by Kopytov et al. (2025) - provides an opportunity to integrate ctDNA analysis, imaging and potentially traditional biomarkers into a new model for precision oncology, including risk stratification and treatment selection. By joining these modalities, investigators may overcome limitations associated with single modalities alone.

5.3 Regulatory and Ethical Considerations for AI-Based Diagnostics

The regulatory pathway for AI-based diagnostic systems remains evolving. The FDA has approved several diagnostic systems that use AI algorithms. The FDA continues to refine the regulatory

frameworks for adaptive algorithms that can learn from the data that they collect from patients. Ethics considerations for these AI-based diagnostic systems include ensuring that the algorithms are fair to all patient demographics, ensuring transparency in the decision-making processes of these systems, protecting the privacy of patients that are involved in the collection of data for these systems and establishing accountability for the errors that AI-based diagnostic systems may commit to patients (Ebbert et al., 2025).

6. Equity Dimensions of Cancer Screening Access

6.1 Disparities in Current Screening Utilization

There are important disparities in cancer screening rates among different socioeconomic, racial/ethnic, geographic and insurance statuses. For instance, people from lower socioeconomic statuses, racial/ethnic minorities, people living in rural areas and those who are uninsured or underinsured have lower cancer screening rates compared to those from higher socioeconomic statuses, non-minority populations, people living in urban areas and those with insurance (Carbonell et al., 2024). These disparities in cancer screening rates are related to a variety of barriers to care, such as lack of insurance, limited access to healthcare providers, transportation issues, language barriers, cultural factors and mistrust of the medical community due to historical injustices. These disparities result in differences in the stage at which people are diagnosed with cancer, as well as different outcomes for those cancers. For instance, Black Americans have a 20% higher mortality rate from colorectal cancer compared to White Americans, which is related to the lower screening rates and later diagnosis of colorectal cancer for Black Americans (Hassan et al., 2025). These disparities exist for breast, cervical and lung cancers as well.

6.2 Will MCED Tests Exacerbate or Ameliorate Disparities?

The introduction of MCED tests also raises questions about the potential for inequities within the population that will have access to these tests. On one hand, these tests could potentially reduce the inequities within the population by providing a non-invasive test that can be performed during routine clinical visits (Imai et al., 2025). On the other hand, the costs of these tests, the lack of insurance coverage for these tests and the concentration of these tests within well-resourced healthcare systems could potentially exacerbate existing inequities within the population (Sasieni et al., 2025). The only way to ensure that MCED tests are implemented equitably within the population is to implement

policies that provide for insurance coverage of these tests, subsidies for low-income people to have these tests performed and the deployment of these tests within community health centers and safety-net settings.

6.3 Global Health Perspectives

While the vast majority of cancer mortality happens in low- and middle-income countries (LMICs), many high-income countries have begun to introduce MCED tests, despite the lack of such screening modalities for many LMICs. Chen et al. (2025) reported on the potential for MCED tests to improve cancer screening outcomes but also recognized the need for methods that would enable these tests to be performed in resource-constrained settings. To address this issue, many strategies have been proposed for enhancing global access to MCED tests, including technology transfer, pricing models for LMICs, development of simpler MCED tests for LMICs and integration of MCED tests into existing healthcare infrastructure for LMICs.

7. Rethinking the Detection Paradigm: An Integrated Framework

7.1 From Single-Cancer to Multi-Cancer Screening

It is a important change from testing for one type of cancer at a time to testing for many different types of cancer at once. This can affect how we plan screening tests, how healthcare services are delivered and how resources are shared. MCED tests can reduce the number of blood draws needed for a full cancer screening and potentially increase the number of people who get screened. MCED tests are particularly useful for cancers where there is no established screening test. However, MCED tests also reduce the burden of taking multiple separate tests (Guerra et al., 2023). It is needed to consider how to make multi-cancer screening work well, for instance, by planning screening programmes, diagnostic pathways and healthcare services. Figure 2 illustrates the components of a structure for integrated multi-cancer screening.

Figure 2: Components of an Integrated Multi-Cancer Early Detection Framework

Component	Current Paradigm	Proposed MCED Paradigm	Implementation Requirements

Screening modality	Organ-specific tests (mammography, colonoscopy, etc.)	Blood-based multi-cancer detection	Validated MCED tests with clinical utility evidence
Cancer coverage	4-5 cancer types with USPSTF recommendations	50+ cancer types simultaneously	Comprehensive biomarker panels with high sensitivity
Screening interval	Annual to every 10 years depending on modality	Annual or biennial blood draw	Longitudinal performance data to optimize intervals
Diagnostic workup	Organ-specific imaging and biopsy protocols	Tumor-of-origin prediction guiding targeted workup	Efficient diagnostic algorithms for positive results
Risk stratification	Age, family history, exposure-based	Integrated risk models incorporating biomarkers, genetics, clinical factors	Validated risk prediction models
Equity considerations	Variable access across populations	Universal access through policy interventions	Insurance coverage, subsidized testing, community deployment

This structure points to several key principles. First, MCED tests should not replace but rather work alongside other screening methods, at least until more definitive data comparing their benefits are available. Second, it is important to create efficient pathways for diagnosis to shorten time to diagnosis and reduce unnecessary processes. Third, screening intensity should scale with risk level: higher-risk people might gain more benefit from more frequent testing or by using multiple screening methods. Finally, equity considerations should be embedded in the design and implementation of MCED efforts, rather than being addressed after the fact.

7.2 Addressing Diagnostic Delay Through System Redesign

The reduction of diagnostic delay for MCED requires interventions throughout the care continuum. While MCED tests are able to reduce the time of diagnostic delay for MCED, it is still necessary to implement system level interventions to the whole care continuum. Such interventions include

increasing the ability of primary care clinics to recognize cancer and refer to specialists, streamlining the diagnostic process for MCED, preventing patients from being "lost to follow-up," and providing patient navigation services to help people navigate the complex healthcare system (Tursunalievna, 2023). Also, MCED tests must be carefully integrated into clinical workflows. For instance, the PATHFINDER study indicated that the median time to diagnostic resolution for MCED positive tests was 79 days (Ebbert et al., 2025).

7.3 The Role of Chronic Disease Detection

Although this paper focused mainly on cancer detection, the liquid biopsy technologies could potentially be used to detect other chronic diseases early. Those diseases could be heart diseases, neurodegenerative diseases or metabolic diseases. Cell-free DNA, RNA, proteins and metabolites in blood reflect pathological processes for many disease states other than cancer. Development of tests that detect multiple diseases simultaneously by screening for both cancer and chronic diseases seems like a logical extension of current multi-cancer early detection (Kisiel et al., 2024). But finding chronic diseases is a different problem than cancer screening. Many of these chronic diseases progress over years or decades. That means there's a longer window for intervention but it also means there are more questions about the best time and frequency to screen. But finding chronic diseases such as Alzheimer's disease, chronic kidney disease or cardiovascular disease early, could potentially lead to interventions that slow their progress and improve quality of life.

8. Future Directions and Research Priorities

8.1 Validation and Clinical Utility Studies

The most pressing research priority is to rigorously prove MCED clinical utility through large, prospective screening trials that measure outcomes over long periods. These trials should demonstrate that MCED screening improves patient outcomes, including lower cancer and all-cause mortality, quality of life and cost-effectiveness, compared to current screening methods or no screening at all. The ongoing SUMMIT study will provide critical evidence for MCED clinical utility through a randomized controlled trial in 50, 000 participants comparing MCED screening to usual care (Sasieni et al., 2025). Other research priorities include defining best screening intervals, identifying subpopulations that benefit most from MCED screening and developing risk-based screening plans. MCED tools also require validation in diverse populations to ensure that results apply across different

demographic groups, with enough racial and ethnic minorities, older adults and those with other comorbidities included in validation studies to maintain population generalizability (LeeVan et al., 2023).

8.2 Technology Development and Cost Reduction

The field still needs to be furthered through technology improvements for the detection of early stage diseases, higher accuracy of tumour origin prediction, lower false alarm rates and cost savings. Nguyen et al. (2023) reported that the shallow sequencing approach could perform at a high level of accuracy at a much lower cost than high-depth sequencing but more cost savings are still needed to allow for the screening of whole populations. Researchers need to continue the study of new biomarkers beyond ctDNA. Bratulic et al. (2022) reported encouraging results from the analysis of glycosaminoglycans and other teams have investigated circulating tumour cells, exosomes, microRNAs and protein biomarkers. The combination of different classes of biomarkers might yield the best balance of sensitivity and specificity but this could also increase the complexity and cost of screening.

8.3 Implementation Science and Health Policy Research

Effective, affordable MCED tests must overcome practical, organizational and policy obstacles. Implementation science research must determine best strategies for integrating these tests into clinical workflows, teaching healthcare providers how to interpret results and manage them and for communicating results to patients and coordinating diagnostic workup. Concurrently, health policy research must determine insurance coverage decisions, reimbursement models and regulatory pathways, as well as equity interventions, including international collaboration for cancer detection in global populations, especially in high-income countries (Ebbert et al., 2025). Specific topics may include technology transfer agreements, ability building in LMICs and development of simplified assays for resource-limited settings. The global cancer burden is expected to increase substantially in the coming decades, with the majority of this increase happening in LMICs (Chen et al. 2025).

9. Conclusion

Cancer and chronic disease detection is at an inflection point. New technologies have new ability to identify early disease. Liquid biopsy, multi-cancer early detection and artificial intelligence-based diagnostics have shown technical feasibility. These technologies also showed promise in validation studies. They address long-standing limitations in screening, including limited cancer coverage,

invasiveness and poor sensitivity for early disease. However, more than technical innovation is needed. Evidence of improved patient outcomes from prospective screening trials is required to show clinical utility. Definitive clinical utility evidence is required from these trials. Cost reductions are required to make screening economically feasible.

Strategies to shorten these pathways are needed and should be implemented as soon as possible. Also, policy interventions are required to ensure that screening reaches all population groups without worsening the gap in health equity. The paper suggests new perspectives to address cancer screening that stress some important elements. These are the combination of biomarkers with different characteristics, the change from single- to multi-cancer screening, the integration of risk stratification algorithms, the implementation of health care system policies to reduce delays in cancer diagnosis and the emphasis on equity in the implementation of new technologies for cancer detection. These principles could be considered as guidelines for the development, validation and implementation of the new technologies in cancer screening.

The missed signal of cancer that has claimed countless lives can be captured by emerging detection technologies. However, the challenges of cancer detection cannot be solved by technology alone. To effectively address the challenges of cancer detection, technical innovation must be implemented alongside thoughtful implementation strategies, strong evidence generation and a commitment to equity. Also, the challenges of cancer detection demand collaboration between different disciplines.

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