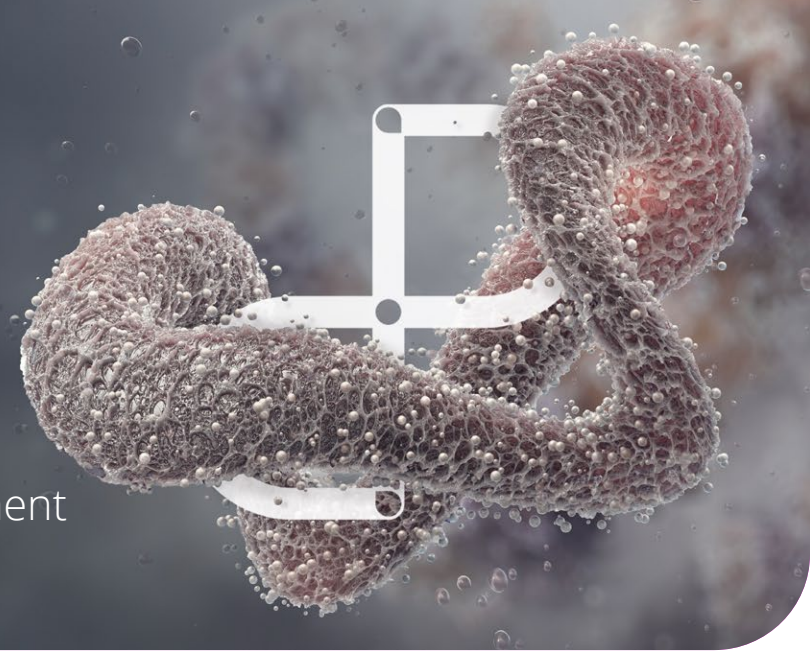
CAMBRIDGE DESIGN PARTNERSHIP

EMERGING BIOMARKERS AND THE CASE FOR SYSTEM DIVERGENCE

Why biomarker translation stalls at assay and IVD product development





Author:
James Blakemore
Senior Insights and Strategy Consultant of Life Sciences and Diagnostics
Cambridge Design Partnership

The life sciences sector continues to generate a steady stream of compelling candidate biomarkers, yet comparatively few translate into products that a clinical laboratory can run routinely, enabling a clinician to act with confidence. The lab to clinician gap is rarely the fault of the biomarker, but instead sits with the sample handling, assay development, and manufacturing that's needed to turn a validated biological signal into an in vitro diagnostic (IVD) product.

For CTOs and R&D leadership, this creates a difficult choice. The most straightforward path is to fit a promising biomarker into an existing platform, workflow and test ecosystem. This has led to a convergence of product strategy by the diagnostics industry: assay menus are extended, testing platforms improved incrementally, and layering additional software-based interpretation onto assays that are already validated and in routine use. Each of these carries substantially lower adoption risk than building a new system, but limits how impactful the platform can be for the clinician treating the patient.

One of the greatest sources of differentiation for the life sciences industry is the translation of emerging biomarkers whose significance is not purely additive. Rather than extending an existing menu, these biomarkers redefine the clinical question being asked: enabling earlier detection, continuous monitoring of disease activity, or patient stratification and treatment selection strategies that were not previously feasible. But because they change the underlying question, they frequently require new innovative infrastructure to answer it.

This is the challenge facing the industry: whether to pursue the harder, more differentiated product development problem, or to take the safer route toward incremental clinical and commercial gain that your competitors already follow?

© 2026 CAMBRIDGE DESIGN PARTNERSHIP

PLATFORM CONVERGENCE LIMITS EMERGING BIOMARKERS

The problem is not a lack of ambition among scientists and engineers. The existing development system itself makes the safer option easier to pursue and justify: validated workflows, established regulatory pathways, existing manufacturing and laboratory infrastructure, lower adoption friction, and a more straightforward investment case.

These advantages make convergence the rational choice, but they can also become a constraint. Biomarkers with the greatest transformative potential may not fit comfortably onto platforms designed and optimized for other purposes. Capturing their value typically requires organizations to diverge from established systems and design a platform around the specific requirements of the underlying biology, rather than adapting the biology to an existing platform.

Why the safer path wins by default:

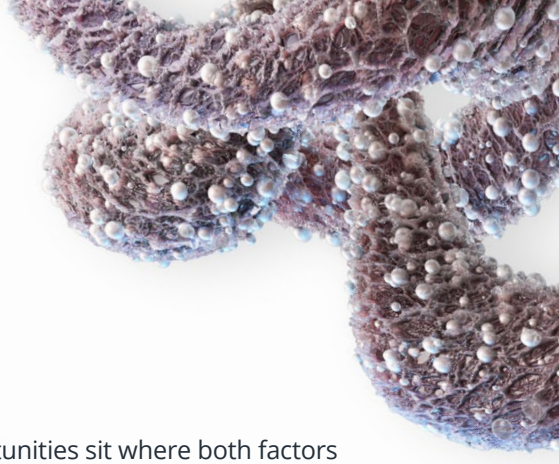
- **Validated workflows**
- **Established regulatory pathways**
- **Existing manufacturing and laboratory infrastructure**
- **Lower adoption friction**
- **Simpler investment case**

WHERE BIOMARKER DIFFERENTIATION ACTUALLY COMES FROM

The greatest opportunities for differentiation begins with biomarkers that enable something existing products cannot. The example biomarkers described in this paper represent translational challenges for innovative life sciences companies. For many of these companies, product development decisions, such as sample preparation logistics or diagnostic consumable design, tend to come too late. Instead, they are made after the science is essentially finished, once the most cost-effective and clinically consequential changes are no longer available.

This is where the challenge becomes one of product strategy. **Biomarker discovery and qualification, including generating the first proof-of-principle evidence, is a high-risk, high-reward bet** for R&D departments at established diagnostic companies and startups alike. This is the stage at which Cambridge Design Partnership (CDP) has been successful in helping organizations make the differentiated opportunity possible, translating the biomarker and working out what must be true of the sample, the assay and the manufacturing process to become a reliable, differentiated product.

© 2026 CAMBRIDGE DESIGN PARTNERSHIP



A FRAMEWORK FOR EVALUATING BIOMARKER TRANSLATIONAL RISK

Two fundamental properties help identify which opportunities have the greatest potential value. The first is the extent to which a biomarker creates **step-change clinical value**, in the ways described earlier. The second is the degree of **change required to the product architecture** that delivers it. Figure 1 sets out a simple way of mapping biomarkers against these two dimensions.

The greatest opportunities sit where both factors are high. Although this inherently means these opportunities are harder to develop and realize, they create the greatest potential for differentiation. The question is no longer whether to make the workflow change but where the clinical value is high enough to warrant pursuing it.

FIGURE 1

A FRAMEWORK FOR EVALUATING BIOMARKER TRANSLATIONAL RISK

	LOW WORKFLOW CHANGE	HIGH WORKFLOW CHANGE
STEP-CHANGE CLINICAL VALUE	**DIFFERENTIATED AND COMPATIBLE** Step-change clinical utility, delivered through an already-standardized workflow. e.g., p-tau217 blood tests.	**DIFFERENTIATED AND HARD TO COMMERCIALIZE** Real upside, but the system to deliver it reliably doesn't exist yet. e.g., alpha-synuclein SAA; metagenomic AMR prediction; decentralized tumor-informed MRD testing.
INCREMENTAL CLINICAL VALUE	**INCREMENTAL AND COMPATIBLE** Modest clinical utility, delivered through an already-standardized workflow (low risk, low differentiation). e.g., new actionable mutations added to existing genomic panels.	**INCREMENTAL AND COSTLY** Modest clinical utility, but a disproportionate change in workflow to deliver it. e.g., circulating tumor cells.

© 2026 CAMBRIDGE DESIGN PARTNERSHIP

THREE EMERGING BIOMARKERS AND THEIR TRANSLATION CHALLENGES

The examples below, drawn from neurology, infectious disease and oncology therapy areas, illustrate this framework in terms of where a given biomarker's translational challenge is likely to sit, and, in most cases, why that challenge is still unsolved.

The three cases below cluster in the top right quadrant of figure 1 deliberately, since this is where some of the most interesting current translational challenges sit.

1. Neurology

- No standardized sample route
- Alpha-synuclein seed amplification assays

What it does

- Flags Parkinson's disease potentially years before motor symptoms

The barrier

- Proven in cerebrospinal fluid and skin biopsy, but no accessible route yet

What closes the gap

- A validated collection and stabilization protocol that works outside specialist clinics

2. Infectious disease

- No complete reference base

Metagenomic sequencing and AMR prediction

What it does

- Identifies almost any pathogen and its resistance profile in one test

The barrier

- Resistance-gene databases are incomplete and short reads lack context

What closes the gap

- A validated reference base, reproducible calling pipeline and acute-care turnaround

3. Oncology

- No distributable workflow
- Tumor-informed ctDNA for MRD testing

What it does

- Detects residual cancer after surgery to guide treatment decisions

The barrier

- FDA-approved, but each assay is built bespoke per patient in the manufacturer's own labs

What closes the gap

- A design, manufacture and QC pipeline other laboratories can run

© 2026 CAMBRIDGE DESIGN PARTNERSHIP

1. Neurology

NO STANDARDIZED SAMPLE ROUTE: ALPHA-SYNUCLEIN SEED AMPLIFICATION ASSAYS IN NEUROLOGY

Alpha-synuclein seed amplification assays test whether a patient sample can template the misfolding of added, healthy alpha-synuclein protein, rather than simply measuring how much protein is present. This mechanism lets the assay flag Parkinson's disease and other protein folding-related pathologies potentially years before a clinical motor diagnosis is possible, opening a window for earlier intervention that symptom-based diagnosis cannot reach.

The assay performs strongly in cerebrospinal fluid and skin biopsy, but both require an invasive or specialist sample. A genuinely accessible route, such as whole blood, remains an emerging and unreconciled research problem rather than a working alternative, and no company has yet scaled the assay beyond a laboratory-developed test licensed to a small number of accredited labs.

Closing the biofluid gap is a pre-analytical, sample-acquisition and standardization exercise, not a question of further biomarker science: a validated collection and stabilization protocol robust enough to travel outside a specialist neurology clinic, and a route to scaled, cleared distribution behind it. None of that depended on the biomarker being settled, and all of it could have run alongside. Because it didn't, an assay with proven diagnostic accuracy cannot translate into routine clinical use.

2. Infectious disease

NO COMPLETE REFERENCE BASE: METAGENOMICS SEQUENCING AND ANTIMICROBIAL RESISTANCE PREDICTION

Metagenomic sequencing reads all the nucleic acid in a sample rather than testing for one organism at a time, and researchers are now pursuing pathogen identification and resistance-gene detection from the same unbiased read. A single test ruling in or out almost any infectious cause and its resistance profile would remove the need to guess the right target first.

Reliable pathogen identification from a patient sample increasingly works. Antimicrobial resistance (AMR) prediction lags behind, and the gap is both partly biological and computational: resistance-gene databases draw mainly on bacteria that are easy to culture, so genotype does not reliably predict phenotype even for well-studied organisms, and some resistance mechanisms remain uncharacterized. Short-read sequencing compounds this: assigning a resistance gene to its source organism rather than to background noise needs genomic context that short reads often lack, a limitation that persists even where sequencing infrastructure is already widely installed.

Closing the gap needs the resistance-gene reference base completed and validated, not simply better bioinformatics built on an incomplete one, alongside a reproducible pipeline for calling a true signal from noise, fast enough to inform treatment decisions in acute and intensive care rather than confirm them afterwards. Until the reference database, the calling pipeline, and a turnaround fast enough for acute care all exist together, the assay cannot become a rapid, decentralized test a physician could order directly. Solving these together is as much a metagenomic diagnostics development challenge as a sequencing one.

3. Oncology

NO DISTRIBUTABLE WORKFLOW: TUMOR-INFORMED ctDNA AND MINIMAL RESIDUAL DISEASE TESTING

Tumor-informed circulating tumor DNA (ctDNA) testing is a liquid biopsy approach that sequences a patient's resected tumor first to identify a set of patient-specific mutations, then tracks those exact variants in blood at concentrations far below what a standard panel could reliably detect, to establish whether minimal residual disease (MRD) remains after surgery. Its most clinically consequential use, deciding whether to give or withhold treatment on the basis of a post-surgical result rather than only flagging recurrence risk, has now been tested prospectively in muscle-invasive bladder cancer, and in May 2026 the first such assay received FDA approval as a companion diagnostic for that indication.

That approval shows that the mass-personalization problem can be solved, and it also shows what solving it required. Because each patient's assay is designed afresh from that patient's own tumor, the approved device is not one assay validated once but a pipeline of bespoke design, manufacture and quality control run for every patient, and it is performed only on qualified instruments within the manufacturer's own laboratories. The same architecture has since received IVDR certification across multiple tumor types, yet where other laboratories offer tumor-informed MRD testing, they have done so by licensing a laboratory-developed test rather than by running a distributable product under their own quality systems. Detection at the lowest ctDNA concentrations also remains demanding, and further analytical work in low-positive samples is a condition of the FDA approval.

This is fundamentally a liquid biopsy product development challenge. Taking the approach beyond a single, vertically integrated laboratory requires that pipeline to be engineered into something other laboratories can operate: the design, primer manufacture and verification of a new patient-specific assay, executed consistently at sites the originator does not control. None of that is a biomarker question; it is a MRD assay development, design for manufacturing and quality engineering one. The approval itself illustrates the cost of resolving such questions late. The assay used to select patients in the pivotal trial underwent design changes as it became the commercial device, so approval rested on retrospective bridging of banked trial samples, with post-market studies required to supplement concordance between the two. The requirement was specifiable from the moment the approach was conceived, yet the product that reached approval was not the assay the trial had used.



© 2026 CAMBRIDGE DESIGN PARTNERSHIP

ASSAY AND PRODUCT DECISIONS
MUST START BEFORE THE SCIENCE FINISHES

These examples demonstrate a common risk to realizing the full potential of these biomarker strategies: **the science finishes before the product decisions begin**. By then, the opportunity to make meaningful changes to the product has shrunk, and the cost increased.

The next wave of differentiation in this field will not come from biomarker discovery in isolation. Rather, it will come from **organizations prepared to diverge from platform convergence early enough in development for it to matter**. This means treating sample acquisition, assay performance, consumable architecture, automation, design for manufacture and cost of goods from the outset, not as downstream engineering considerations.

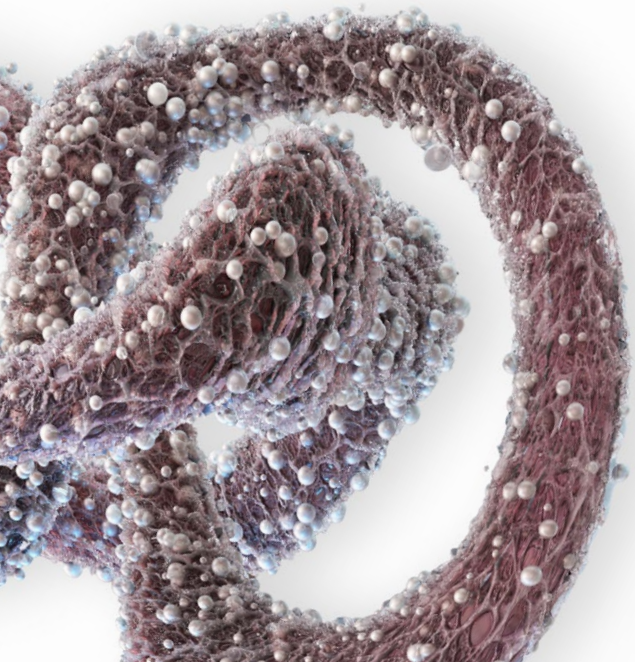
The earlier these decisions are made, the more opportunity to build the product around the biology, and the greater the chance of translating that differentiation into commercial success.

The science finishes before the product decisions begin

Differentiation will come from organizations prepared to diverge from platform convergence early enough in development for it to matter

Address from the outset:

- Sample acquisition
- Assay performance
- Consumable architecture
- Automation
- Design for manufacture
- Cost of goods



FROM BIOMARKER TO IVD PRODUCT DEVELOPMENT

Turning a validated biological signal into a manufacturable, regulatory-compliant IVD product is where CDP's work is concentrated day to day. Across point-of-care, home and lab-based diagnostic product development, we help organizations tackle the product-development challenges that emerge when existing platforms no longer fit.

We help make divergence possible by identifying constraints early, resolving critical engineering unknowns, testing dependencies and building the evidence needed to determine whether a differentiated opportunity is worth pursuing.

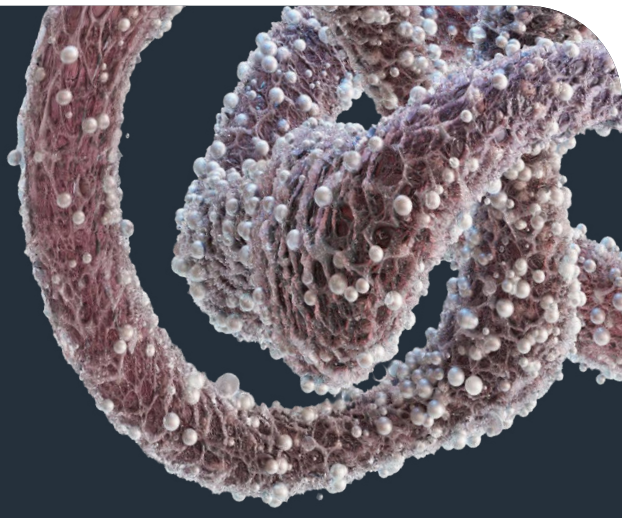
The pattern described in this paper repeats at the level of individual projects: an assay that must function fully from within a decentralized testing environment rather than a laboratory, a sample-preparation step redesigned around an unstable analyte, or a reader built around a novel detection principle. These product-development challenges sit inside an ISO 13485-certified quality system because the resulting devices become regulated products, not research prototypes, and the two demand different disciplines.

The organizations that succeed over the next decade are unlikely to be distinguished primarily by the novelty of their biomarker. They will be those that understand early enough what translating it would actually require for real-world application and are willing and able to act on it.

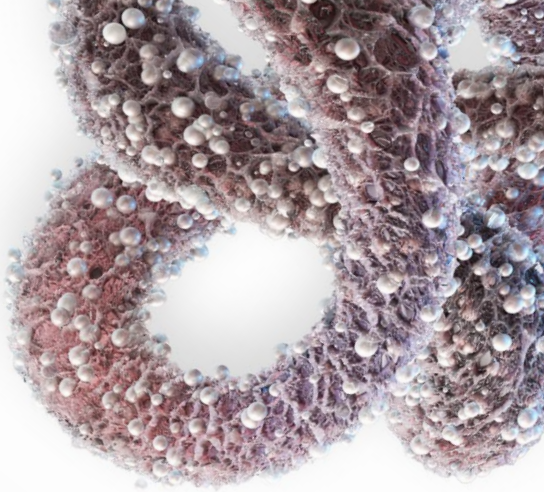
If you have a biomarker with the potential to change clinical practice, start the product conversation early with an assay development partner. CDP can make divergence manageable by helping you understand, test and de-risk what needs to change to turn that potential into a differentiated product.

Case study:

Recently we engaged in a complex diagnostic program on behalf of a venture-backed start-up organization, helping the client translate the underlying biology and laboratory workflow into product definitions and system requirements. By prioritizing the biology-led technical risk areas, we shaped a preferred architecture for the consumable, instrument and automation, with a focused proof-of-principle plan for the next phase of development.



© 2026 CAMBRIDGE DESIGN PARTNERSHIP



Bio:

James Blakemore is a Senior Insights and Strategy Consultant of Life Sciences and Diagnostics at Cambridge Design Partnership (CDP) with a scientific R&D background and over 15 years' experience of business and technology consulting. He undertakes market strategy assignments on behalf of medical technology and consumer healthcare clients, combining insights from stakeholder needs, market dynamics, technology trends and organizational capability to identify impactful portfolio development opportunities. Prior to consulting, he held research and leadership positions in biopharma companies, including GSK and Sosei Heptares and has a PhD in molecular biology from King's College, University of London.

About CDP:

For nearly 30 years, CDP has helped life sciences and diagnostics teams turn groundbreaking ideas into instruments, software and control systems that work, proving clinical performance in real-world use and reaching market faster.

Solving complex product development challenges for the real world

CONTACT US >

CAMBRIDGE DESIGN PARTNERSHIP

© 2026 CAMBRIDGE DESIGN PARTNERSHIP

Bibliography:

1. US Food and Drug Administration. FDA clears first blood test used in diagnosing Alzheimer's disease [Lumipulse G pTau217/β-Amyloid 1-42 Plasma Ratio, Fujirebio Diagnostics]. News release, 16 May 2025. https://www.fda.gov/news-events/press-announcements/fda-clears-first-blood-test-used-diagnosing-alzheimers-disease

2. Roche Diagnostics. Roche receives FDA clearance for Elecsys pTau217, advancing Alzheimer's disease assessment across primary and specialty care. Press release, 24 August 2026. https://www.roche.com/investors/updates/inv-update-2026-08-24

3. Palmqvist S, Tideman P, Mattsson-Carlgren N, et al. Blood biomarkers to detect Alzheimer disease in primary care and secondary care. JAMA. 2024;332(15):1245–1257. https://doi.org/10.1001/jama.2024.13855

4. US Food and Drug Administration. List of FDA-authorized companion diagnostic devices (in vitro and imaging tools). Accessed 24 September 2026. https://www.fda.gov/medical-devices/in-vitro-diagnostics/list-fda-authorized-companion-diagnostic-devices-in-vitro-and-imaging-tools

5. Nicolò E, Reduzzi C, Pierga JY, et al. International expert consensus on the clinical integration of circulating tumor cells in solid tumors. Eur J Cancer. 2025;231:116050. https://doi.org/10.1016/j.ejca.2025.116050 (corrigendum: Eur J Cancer. 2026;233:116167)

6. Siderowf A, Concha-Marambio L, Lafontant DE, et al. Assessment of heterogeneity among participants in the Parkinson's Progression Markers Initiative cohort using α-synuclein seed amplification: a cross-sectional study. Lancet Neurol. 2023;22(5):407–417. https://doi.org/10.1016/S1474-4422(23)00109-6

7. Rissardo JP, Fornari Caprara AL. Alpha-synuclein seed amplification assays in Parkinson's disease: a systematic review and network meta-analysis. Clin Pract. 2025;15(6):107. https://doi.org/10.3390/clinpract15060107

8. Bernhardt AM, Nemati M, Boros FA, et al. α-Synuclein seed amplification assays from blood-based extracellular vesicles in Parkinson's disease: an evaluation of the evidence. Mov Disord. 2024;39(8):1269–1271. https://doi.org/10.1002/mds.29923

9. Mayo Clinic Laboratories. Mayo Clinic Laboratories and Amprion announce collaboration to advance neurodegenerative disease diagnostics. News release, 26 March 2025. https://news.mayocliniclabs.com/2025/03/26/mayo-clinic-laboratories-and-amprion-announce-collaboration-to-advance-neurodegenerative-disease-diagnostics/

10. MLM Medical Labs. MLM Medical Labs and Amprion announce strategic collaboration to expand access to α-synuclein testing in Europe. News release, 13 August 2026. https://www.mlm-labs.com/news/mlm-amprion-collaboration/

11. Lashuel HA, Surmeier DJ, et al. Alpha-synuclein seed amplification assays: data sharing, standardization needed for clinical use. Sci Adv. 2025;11:eadt7195. https://doi.org/10.1126/sciadv.adt7195

12. Bellomo G, Paoletti FP. α-Synuclein seed amplification assays: high promise, real-world variability, and an urgent need for standardization. Neurology. 2026;106(4):e214719. https://doi.org/10.1212/WNL.0000000000214719

13. Pinzauti D, Biazzo M, Podrini C, et al. An NGS-assisted diagnostic workflow for culture-independent detection of bloodstream pathogens and prediction of antimicrobial resistances in sepsis. Front Cell Infect Microbiol. 2025;15:1656171. https://doi.org/10.3389/fcimb.2025.1656171

14. Charalampous T, Alcolea-Medina A, Snell LB, et al. Routine metagenomics service for ICU patients with respiratory infection. Am J Respir Crit Care Med. 2024;209(2):164–174. https://doi.org/10.1164/rccm.202305-0901OC

15. Gschwind R, Ugarcina Perovic S, Weiss M, et al. ResFinderFG v2.0: a database of antibiotic resistance genes obtained by functional metagenomics. Nucleic Acids Res. 2023;51(W1):W493–W500. https://doi.org/10.1093/nar/gkad384

16. Mahfouz N, Ferreira I, Beisken S, von Haeseler A, Posch AE. Large-scale assessment of antimicrobial resistance marker databases for genetic phenotype prediction: a systematic review. J Antimicrob Chemother. 2020;75(11):3099–3108. https://doi.org/10.1093/jac/dkaa257

17. Cao J, Ye Z, Pan J. Metagenomics for antimicrobial resistance: from resistome surveillance to mechanistic inference. J Bacteriol. 2026;208(8) https://doi.org/10.1128/jb.00090-26

18. Dyrskjøt L, Birkenkamp-Demtröder K, Nordentoft I, et al. ctDNA-guided immunotherapy following radical cystectomy for muscle-invasive bladder cancer: results from the TOMBOLA trial. Ann Oncol. 2026;37:712–724. https://doi.org/10.1016/j.annonc.2025.12.018

19. Powles T, Kann AG, Castellano D, et al. ctDNA-guided adjuvant atezolizumab in muscle-invasive bladder cancer. N Engl J Med. 2025;393(24):2395–2408. https://doi.org/10.1056/NEJMoa2511885

20. US Food and Drug Administration. Summary of Safety and Effectiveness Data: Signatera CDx (PMA P260004). Approved 15 May 2026. https://www.accessdata.fda.gov/cdrh_docs/pdf26/P260004B.pdf

21. Natera, Inc. Natera announces IVDR certification for Signatera across multiple cancers. Press release, 9 July 2026. https://www.natera.com/company/news/natera-announces-ivdr-certification-for-signatera-across-multiple-cancers/

22. Clinical Lab Products. ctDNA blood test for cancer monitoring launches in Europe [HPH MRD, licensed from Haystack Oncology]. October 2025. https://clpmag.com/disease-states/cancer/ctdna-blood-test-cancer-monitoring-launches-europe/