

Specialty (immuno)assay development and manufacturing for unique biomarkers.

Biomarker research plays a pivotal role in both improving diagnostics as well as modern drug development, as it will enable insights into disease mechanisms, pharmacodynamics, and therapeutic response. Future Diagnostics can support you with measuring biomarkers in (pre-)clinical samples using off-the-shelf assay's. We have the capabilities to run almost every RUO/IVD ELISA, or on our company owned automated immunoassay or clinical chemistry analyzers such as Abbott Alinity I, Beckman Coulter AU680 or IDS i-SYS.

However, chances are that new discoveries expand into novel poorly understood biological pathways, and researchers increasingly encounter targets with limited reagent availability, low abundance, or high structural complexity.

In such cases, the development of specialty (immuno)assays provide a critical bridge between exploratory, discovery and validated analytical methods. At Future Diagnostics assays are being developed within a proven development process of context-appropriate validation and scientific rigor rather than universal regulatory compliance. This prevents unneeded regulatory burden, clinical regulatory constraints, time and resources.

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These assays are optimized for data reliability, flexibility, and scalability throughout the research lifecycle and assays can seamlessly be developed to a true IVD when needed. (see Figure 1)

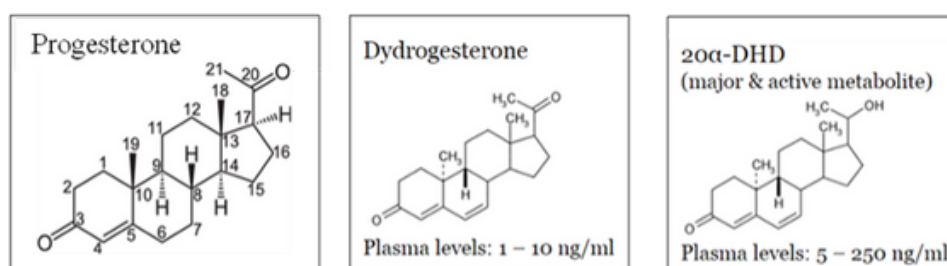


Figure 1. Comparison of native progesterone with dydrogesterone and its major and active metabolite 20α-DHD.

2. The Role of RUO Immunoassays in Biomarker Discovery

Initially, RUO assays are designated for non-clinical research use only, meaning they are not, yet, intended for diagnostic or therapeutic decision-making. Nevertheless, their scientific value is substantial. In early research phases, RUO assays support:

- Novel biomarker exploration and validation
- Mechanistic and pathway analysis in preclinical studies
- Pharmacokinetic (PK) and pharmacodynamic (PD) assessments
- Pre-validation work preceding regulated bioanalytical assay development

By enabling quantitative and reproducible measurement of experimental targets, RUO assays accelerate translational research and provide foundational data for subsequent fit-for-purpose or clinical assay validation.

3. Development Workflow for Specialty Biomarker Assays

Developing a reliable immunoassay for a unique biomarker requires a systematic approach that integrates, assay design, reagent optimization and (bio)analytical performance testing towards the specific needs of our client.



3.1 Feasibility and Target Characterization

- Antigen and antibody evaluation (commercial or custom-generated)
- Assessment of epitope accessibility and cross-reactivity
- Selection of the most appropriate detection platform for its intended purpose (e.g. ELISA, Point-of-care, multiplex, etc.)

3.2 Assay Design and Optimization

- Defining assay format (sandwich, competitive, or bridging)
- Optimizing antibody concentrations, buffers, incubation parameters
- Assessing dynamic range, matrix interference, and background signal

3.3 Analytical Qualification

- Evaluation of precision, linearity, sensitivity, and reproducibility
- Determination of LOD (limit of detection) and LOQ (limit of quantification)
- Initial matrix validation using relevant biological samples

3.4 Documentation and Technology Transfer

- Generation of assay performance reports and standard operating procedures (SOPs)
- Technology transfer to internal or external manufacturing for scale-up

This workflow ensures a robust, research-grade assay that can later be adapted to regulated analytical environments if required.

4. Manufacturing Capabilities

Reliable assay manufacturing is essential for ensuring data consistency across studies and research sites. Specialty RUO manufacturing services include:

- Batch production and QC testing for consistency
- Formulation and stability studies to verify long-term reagent integrity
- Kit assembly with RUO-compliant labeling and documentation
- Certificate of Analysis (CoA) and traceable lot records
- Ongoing supply management for manufacturing continuity

Table 1.

RUO, IUO and IVD— Key Differences



The goal is to provide our clients with reproducible and scalable assay kits or bulk reagents that maintain consistent analytical performance throughout extended research projects.

5. Quality Framework: from RUO to IUO and IVD

Although RUO assays are mostly exempt from diagnostic regulatory requirements, Future Diagnostics applies a fit-for-purpose ISO13485 certified quality management system (QMS) to ensure scientific rigor and reproducibility. Core elements include:

- Controlled raw material sourcing and lot traceability
- Fully documented assay protocols
- Fully traceable qualification data
- Controlled change management for long-term consistency

This approach enables a seamless progression from RUO assay to IUO or fully regulated validation (IVD), using a network of trusted partners minimizing rework as the biomarker matures in the development pipeline (see Table 1 and Figure 3)

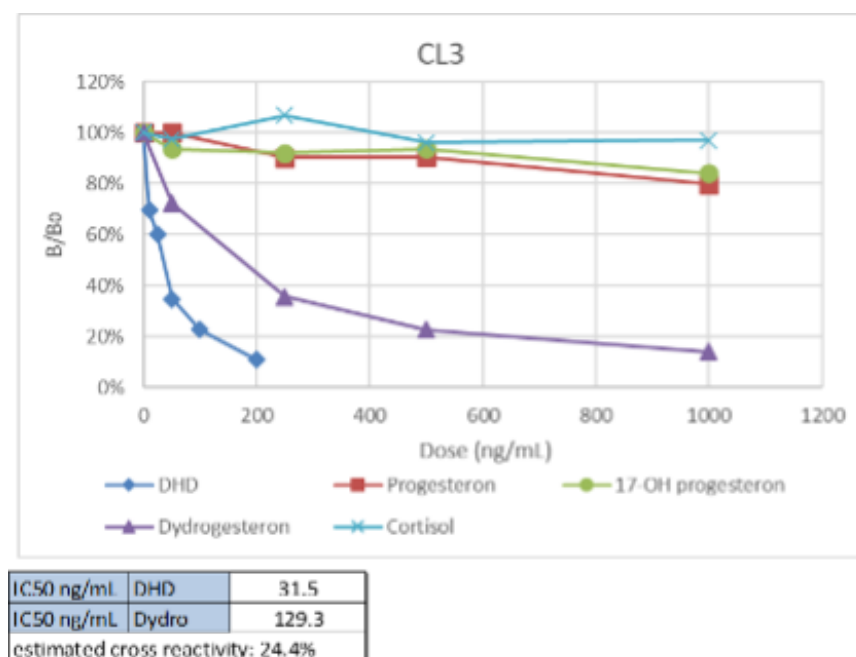


Figure 3.

Specificity of DHD ELISA using the generated anti-DHD CL3 antibody clone.

Category	RUO	IUO	IVD
Full Form	Research Use Only	Investigational Use Only	In Vitro Diagnostic
Primary Purpose	For basic or preclinical scientific research	For clinical investigations to gather data on safety, performance, or	For routine diagnostic testing to inform clinical decisions
Regulatory Intent	Not intended for diagnosis or treatment	Intended for clinical investigation, not routine diagnostics	Intended for clinical diagnostic use on human specimens
Regulatory Oversight (U.S. – FDA)	Exempt from FDA device regulations under 21 CFR 809.10(c)(2)(i)	Regulated under Investigational Device Exemption (IDE) per 21 CFR Part 812	Must be FDA-cleared (510(k)), approved (PMA), or exempt (per 21 CFR 809)
Regulatory Oversight (EU – IVDR)	Not covered under IVDR (EU 2017/746)	Covered under IVDR as an investigational device; requires performance study	Fully regulated under IVDR (EU 2017/746); requires CE marking and notified body
Labeling Requirement (U.S.)	Must state: “For Research Use Only. Not for use in diagnostic procedures.”	Must state: “For Investigational Use Only. The performance characteristics of this product have not been established.”	Must include intended use, performance characteristics, and regulatory clearance (e.g., “FDA cleared”)
Labeling Requirement (EU)	Similar RUO disclaimer required; cannot imply clinical use	Must be labeled as “For performance evaluation only” under IVDR	Must include CE marking, notified body number (if applicable), and intended
Use in Humans	Not permitted for human diagnostic or therapeutic use	Permitted only within approved clinical investigations	Approved for diagnostic use on human samples
Data Generation Purpose	For scientific discovery or assay development	To collect clinical performance and safety data for regulatory	To provide validated, regulatory-approved clinical results
Quality System Requirements (U.S.)	No QSR or GMP compliance required	Partial QSR compliance may be required depending on study	Full compliance with QSR (21 CFR Part 820) required
Quality System Requirements (EU)	No ISO 13485 requirement	Some conformity with ISO 13485 expected during investigations	Full compliance with ISO 13485
Examples	Prototype biomarker assay	New biomarker test under clinical performance study	CE-marked/ FDA-cleared test
End User Limitation	Researchers in academic, pharma, or biotech labs	Clinical investigators in approved studies	Clinicians and diagnostic laboratories

Table 1.
RUO, IUO and IVD— Key Differences

6. Advantages of Specialty (Immuno)Assay Development at Future Diagnostics

Key Advantage	Real life benefit
Customization for Unique Biomarkers	Enables assay design for targets lacking commercial, existing detection tools.
Tailored towards biomarker specific specifications	Optimized towards specific needs depending on intended purpose, such sensitivity and specificity.
Matrix Compatibility	Performance validated in the right (complex) biological fluid such as CSF, whole blood, or tissue lysates.
Flexible Platform Integration	Supports various immunoassay platforms, from ELISA to multiplex and ultrasensitive, automated systems.
Scalability	Smooth transition from research-scale feasibility to large-batch production.
Future Readiness	Establishes a foundation for fit-for-purpose and regulated assay development.

7. Case Study of development of a specialty RUO ELISA

Dydrogesterone (DHD) is an orally active, synthetic progestogen that mimics the effect of naturally occurring progesterone in the body (see Fout! Verwijzingsbron niet gevonden.). It can be used to treat various conditions caused by low progesterone levels such as infertility, menstrual disorders and Menopausal Hormone Therapy (HRT). Future Diagnostics was asked to develop a custom ELISA which can specifically detect DHD (and its active metabolite) to enable monitoring and fine-tuning of DHD effective doses.

8. Conclusion

Specialty (immuno)assay development and manufacturing play a critical role in advancing biomarker science. By applying a fit-for-purpose ISO13585 certified development process using customized assay design and specifications, validation of performance and controlled production processes, these services enable accurate quantification of unique biomarkers that drive translational insights and early (diagnostic) decision-making through the development of a fully validated IVD.

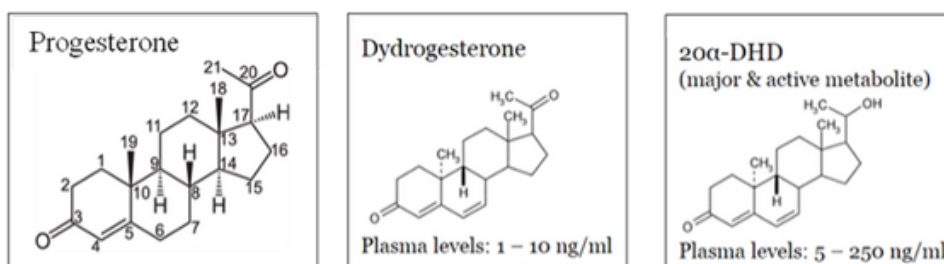


Figure 1. Comparison of native progesterone with dydrogesterone and its major and active metabolite 20α-DHD.

After generation of monoclonal antibodies, a competitive ELISA assay design was developed (Figure 2) and the specificity of the selected antibody (CL3) was investigated (Figure 3). This demonstrated that the assay showed specific reactivity towards dydrogesterone and its metabolite 20α-DHD but not native progesterone or other steroid hormones.

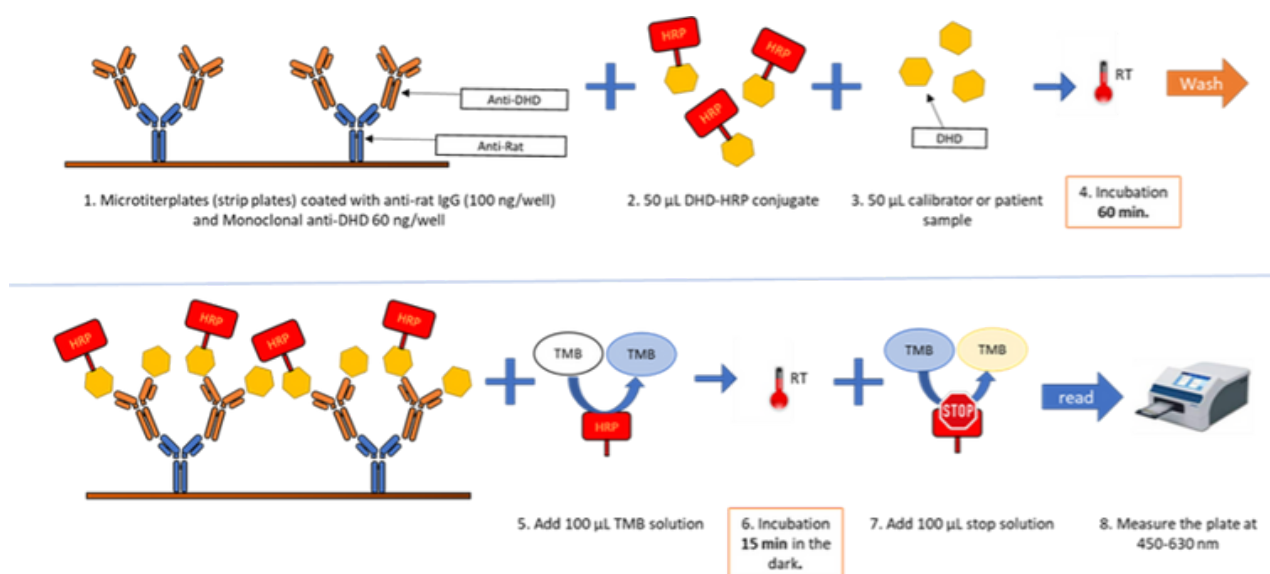


Figure 2. DHD ELISA assay design

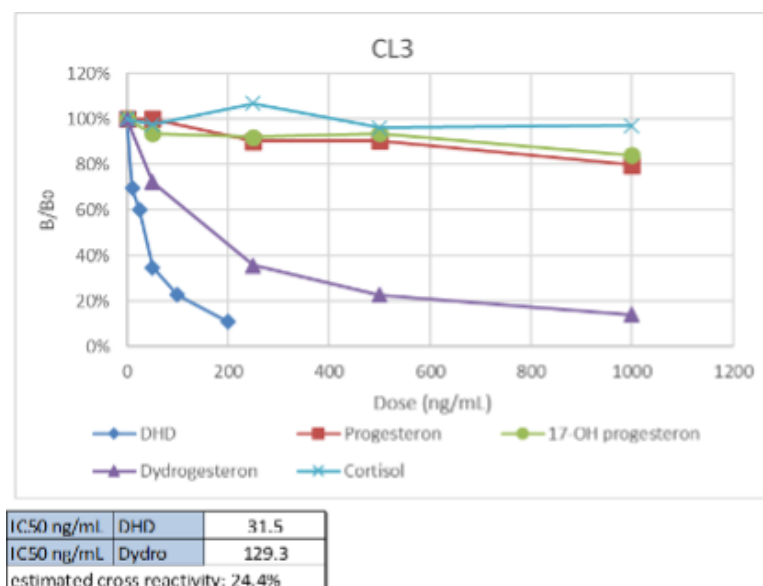
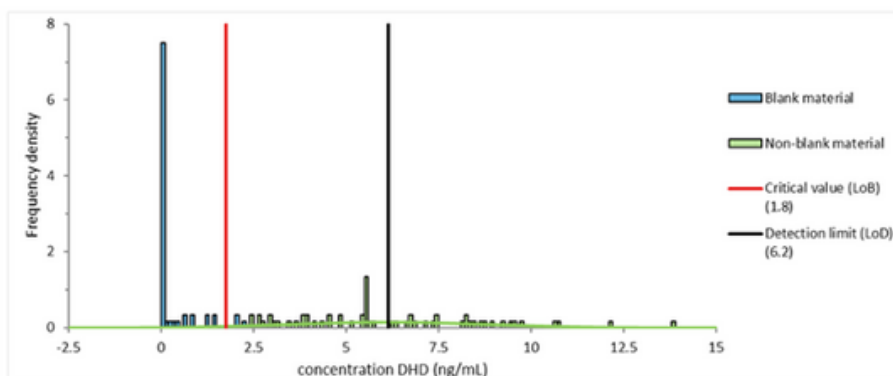


Figure 3. Specificity of DHD ELISA using the generated anti-DHD CL3 antibody clone.

Subsequently, the initial assay design was further developed by optimizing antibody concentrations, assay buffers, incubation parameters etc. During analytical qualification it was demonstrated that the assay achieved a Limit of Detection (LoD) of 6.2 ng/mL, which was well within the required sensitivity (Figure 4) and showed good correlation to the reference method (LC-MS) (Figure 5). Overall, the resulting DHD ELISA assay was ready to be used for future clinical validation.

	Blank		Detection limit		
	N	LoB (ng/mL)	N	Pooled SD (ng/mL)	LoD (ng/mL)
Detection capability study	60	1.8	60	2.7	6.2



Histogram of LoB and LoD samples measured in DHD competitive assay with CL3.

Figure 4.
Detection capability of the DHD ELISA consisting of Limit of Blank (LoB) and Limit of Detection (LoD).

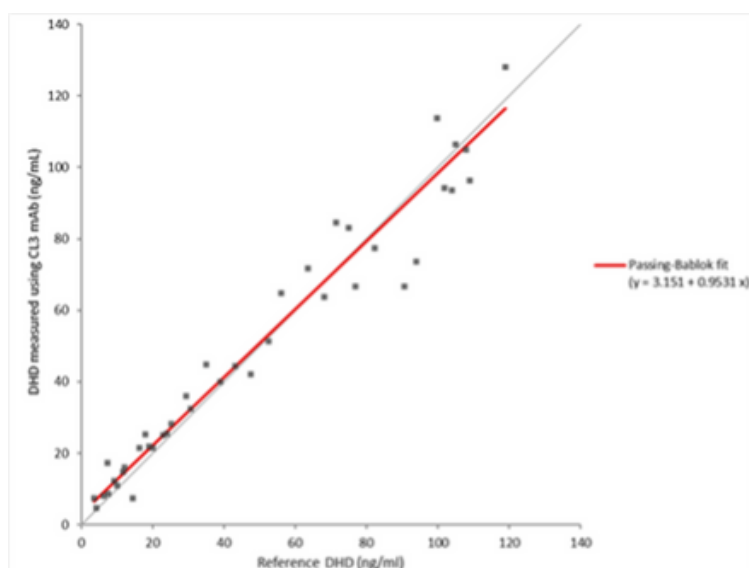


Figure 5.
Method comparison of DHD ELISA with reference method (LC-MS)

Development of biomarker assay's that grows along with your need

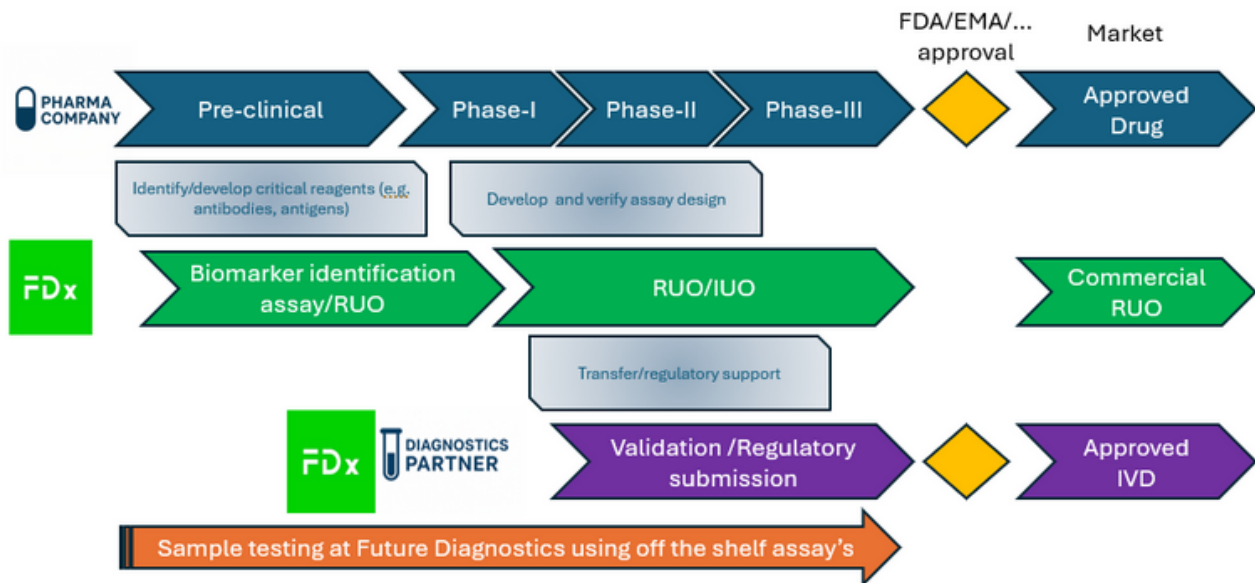


Figure 6.

Schematic overview of the (co-)development process of a specialty (immuno)assay showing various development stages and routes. Depending on the primary purpose of the identified biomarker the associated assay can be developed into a RUO (research use only), and commercialized as such. However, if measurement of the biomarker has the potential to be clinically relevant the assay can be developed to an IUO (Investigational Use Only) assay to collect clinical performance and safety data for regulatory submission. If successful, the IUO can be developed into a true IVD (In vitro Diagnostics), which after regulatory approval can be used in (routine) diagnostic testing to inform clinical decisions

A person wearing a white lab coat and white gloves is working in a laboratory. They are holding a small, rectangular, blue device with both hands. The background is a blurred laboratory setting with various pieces of equipment. The overall lighting is cool and blue-toned.

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