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Lékařská fakulta Univerzity Palackého v Olomouci

NATFORLAB 2026

Future competencies for Laboratory Medicine Specialists

Adapting to the Next Era of Diagnostics & Patient Care

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AGENDA

What We'll Cover in 20 Minutes

1. **Why the field is changing**
   Drivers reshaping laboratory medicine practice
2. **From analyst to integrator**
   How the specialist's role itself is shifting
3. **Five competency domains**
   The capabilities of specialists will need next
4. **Building the future workforce**
   Education, training and a practical roadmap

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Who Works in the Laboratory?

Professional categories of laboratory staff, by role and qualification level

Laboratory Physicians / Pathologists

MEDICAL DOCTOR (MD)

Diagnose disease, provide clinical correlation, and hold ultimate medical responsibility for results.

Clinical Laboratory Scientists / Specialists

MASTER'S / DOCTORAL

Validate complex methods, interpret advanced results, and lead technical and quality decisions.

Medical Laboratory Technologists

BACHELOR'S DEGREE

Perform and troubleshoot routine to complex testing across laboratory disciplines.

Medical Laboratory Technicians

ASSOCIATE DEGREE / DIPLOMA

Carry out standardized procedures and instrument operation under supervision.

Phlebotomists

CERTIFICATE

Collect and handle specimens correctly during the critical pre-analytical phase.

Laboratory Assistants / Aides

ON-THE-JOB TRAINING

Support specimen receipt, processing, and logistics that keep the lab running.

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The Laboratory Generalist

One professional, competent across every major bench of the laboratory

DEFINITION

A laboratory generalist is a medical laboratory professional trained, certified, and clinically competent to perform testing across all major disciplines — hematology, clinical chemistry, microbiology, blood banking, coagulation, and urinalysis — rather than a single specialty area.

In practice: able to rotate across sections, cover staffing gaps, and support smaller or 24-hour labs where narrow specialization isn't feasible.

WORKS ACROSS ALL CORE DISCIPLINES

- Hematology
- Clinical Chemistry
- Microbiology
- Blood Banking
- Coagulation
- Urinalysis

Generalist rotates across all sections at working proficiency
Specialist develops deep, advanced expertise in one discipline

CONTEXT

The Laboratory Landscape Is Shifting Fast

70%
of clinical decisions rely on laboratory data

3-5x
growth in molecular / genomic test volume this decade

30%+
estimated workforce shortfall in many countries by 2030

Automation, AI-assisted diagnostics, point-of-care expansion and precision medicine are redefining what specialists are asked to know and do.

- **Artificial intelligence in multidisciplinary diagnostic interpretation**
- **Genomics, liquid biopsy & precision medicine**
- **Point-of-care and decentralized testing**
- **Rising data volumes & interoperability demands**

THE ROLE IS CHANGING

From Analyst to Knowledge Integrator

TRADITIONAL ROLE

- Sample processing & instrument operation
- Result generation within reference ranges
- Quality control within a single discipline
- Reactive response to physician requests

FUTURE ROLE

- Data integration across omics, imaging & clinical records
- Clinical consultation & diagnostic interpretation
- Governance of AI-assisted and automated systems
- Proactive partner in multidisciplinary care teams

FRAMEWORK

Five Competency Domains for the Future Specialist

1. **Digital & Data Literacy**
2. **Genomics & Precision Medicine**
3. **Clinical Consultation**
4. **Quality & Regulatory Leadership**
5. **Inter-professional Communication**

DOMAIN ONE

1

Digital & Data Literacy

Fluency in the tools that now generate and interpret laboratory data

AI & machine learning basics	Understanding how algorithms flag, triage and classify results — and where they fail
Bioinformatics fundamentals	Working knowledge of pipelines used for sequencing and variant analysis
LIS / middleware mastery	Configuring and troubleshooting the systems that connect instruments to records
Data visualization & analytics	Turning laboratory data into actionable, communicable insight

DOMAIN TWO

Genomics & Precision Medicine

2

Deepening expertise as molecular testing becomes mainstream

Next-generation sequencing interpretation	Translating raw sequence data into clinically meaningful reports
Pharmacogenomics	Guiding drug selection and dosing based on individual genetic profiles
Liquid biopsy & circulating biomarkers	Supporting earlier detection and treatment monitoring
Variant classification & reporting standards	Applying consistent, evidence-based classification frameworks

*N*ext *G*eneration *S*equencing — Method of the Future

***NGS** is shifting from a specialized, centralized capability toward a faster, more automated, AI-integrated, and more widely distributed part of routine clinical diagnostics — with **microbiology** (especially unbiased pathogen detection via mNGS) being one of the fastest-growing frontiers alongside oncology and newborn screening.*

Clinical Area	Current Applications (Now)	Emerging / Future Applications
Oncology / Molecular Pathology	Gene panels for actionable mutations; tumor exome sequencing; fusion panels (solid & hematologic); TMB; MSI	Broader multi-omics companion diagnostics; AI-assisted variant interpretation; routine WGS for tumor profiling
Liquid Biopsy / Cancer Screening	ctDNA monitoring for treatment response and MRD in known cancer patients	Multi-cancer early detection (MCED); tissue-of-origin prediction; population-level screening (utility evolving)
Clinical Genetics / Rare Disease	Gene panels, WES, and WGS for heterogeneous disorders; well-established diagnostic yield	Faster turnaround via automation; AI-assisted VUS interpretation; WGS as first-tier test
Prenatal / Reproductive Medicine	NIPT; carrier screening for single-gene disorders and microdeletions	Expanded carrier panels; integration with preimplantation genetic testing
Newborn Screening	Second-tier NGS to confirm biochemical screening (e.g., inborn errors of metabolism)	Primary genomic newborn screening from dried blood spots; early detection of cancer predisposition
Microbiology — Pathogen Detection	Targeted NGS for resistance genes/strain typing; mNGS in complex cases (e.g., CNS infections, severe pneumonia)	Routine mNGS for undiagnosed infections; faster nanopore workflows (results in hours); broader ICU use
Microbiology — AMR & Surveillance	Resistance gene profiling; outbreak investigation via WGS of isolates	Population-level AMR/HAI surveillance (e.g., wastewater genomic epidemiology); real-time outbreak tracking
Data Analysis / Bioinformatics	Manual/semi-automated variant calling and reporting pipelines	AI as diagnostic collaborator; automated triage; natural-language genomic interpretation
Lab Operations	Centralized specialized labs; turnaround often >1–2 weeks for comprehensive panels	Sample-to-answer automated platforms; decentralization to community labs; shorter instrument cycles (~5.5 yrs)

DOMAIN THREE

Clinical Consultation

3

Moving from result-reporting to active diagnostic partnership

Test utilization guidance	Advising clinicians on the right test, at the right time, for the right patient
Result interpretation in context	Integrating clinical history, imaging and prior results into interpretation
Diagnostic stewardship	Reducing unnecessary testing while improving diagnostic yield
Direct patient communication	Explaining results and implications where regulations allow

DOMAIN FOUR

4

Quality & Regulatory Leadership

Governing increasingly complex and automated laboratory systems

Accreditation & standards (e.g. ISO 15189)	Maintaining and evolving quality management systems
AI & algorithm validation	Verifying performance, bias and safety of automated decision tools
Risk management	Anticipating failure points across increasingly interconnected workflows
Regulatory horizon-scanning	Tracking evolving requirements across jurisdictions

DOMAIN FIVE

Interprofessional Communication

5

Working across disciplines, institutions and borders

Multidisciplinary team participation	Contributing lab expertise to tumor boards and case conferences
Cross-border harmonization	Aligning terminology, units and reporting across health systems
Educating referring clinicians	Building shared understanding of new and complex test types
Patient-centered communication	Translating technical findings into clear, compassionate language

BUILDING THE WORKFORCE

Education & Training Must Evolve Too

Curriculum redesign

Integrate bioinformatics, AI literacy and clinical consultation into core training programs, not electives.

Micro-credentials

Stackable, short-form certifications let specialists build new competencies without leaving practice.

Simulation-based training

Use simulated case data and digital pathology tools to practice interpretation before real-world stakes.

ROADMAP

A Practical Path Forward

Now

Audit current competencies against the five domains; identify institutional gaps

1–3 Years

Embed digital, genomic & consultative training into residency and CE programs

3–5+ Years

Establish career pathways that reward hybrid clinical-technical-informatics expertise

KEY TAKEAWAYS

Three Things to Remember

01 The specialist's role is shifting from data producer to data interpreter and clinical partner.

02 Five competency domains — digital, genomic, consultative, regulatory, communicative — define the future skill set.

03 Training must start now: curricula, CME and career paths all need to evolve together.

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Thanks for your attention !