

National University

**National University – Sudan**
**Faculty of Graduate Studies**
**Faculty of Medical Laboratory Sciences**

# (Ph.D.) by Research in Histopatholgy

## 1. Introduction (Background)

The Doctor of Philosophy (Ph.D.) by Research in Medical Laboratory Sciences with specialization in Clinical Chemistry at National University – Sudan represents the premier doctoral-level research degree in clinical biochemistry and diagnostic sciences. Governance and academic oversight are jointly shared by the Faculty of Graduate Studies and the Faculty of Medical Laboratory Sciences, ensuring strict adherence to highest international scientific and ethical standards.

Unlike traditional taught doctoral degrees that rely on structured course units and lecture series, this program is 100% research-driven (Ph.D. by Research). Doctoral candidates are immersed directly into mentored scientific inquiry from day one. Guided by senior research professors, subject-matter experts, and clinical consultants, candidates design, execute, and analyze groundbreaking original research projects designed to solve critical clinical, diagnostic, and metabolic challenges in Sudan, Africa, and the global healthcare arena.

Throughout their candidacy, scholars undergo rigorous training in advanced molecular biomarker discovery, high-throughput automated analytics, mass spectrometry, therapeutic drug monitoring, total laboratory quality management systems (TQMS), advanced biostatistics, bioinformatics, and ethical research governance. The program culminates in the preparation and oral defense of an exhaustive doctoral dissertation demonstrating substantial, novel contribution to human knowledge.

## 2. Vision

To achieve premier international recognition as a center of doctoral research excellence in Clinical Chemistry, pioneering original scientific discoveries, driving diagnostic technologies, and cultivating transformational academic leaders who elevate patient care and public health outcomes.

## 3. Mission

To deliver high-impact, mentor-driven doctoral education that empowers researchers to conduct original, methodologically sound, and ethically grounded research in clinical biochemistry. The program is committed to advancing diagnostic capacity, fostering interdisciplinary collaboration, and serving national and global healthcare needs.

## 4. Goals

- Advance the field of medical laboratory sciences through high-quality, methodologically sound, and clinically relevant research.
- Develop innovative, evidence-based solutions to diagnostic, biomedical, and public-health challenges facing Sudan and the wider region.
- Strengthen laboratory research capacity, infrastructure, and quality-management

systems, both nationally and internationally.
- Promote interdisciplinary collaboration among laboratory sciences, medicine, pharmacy, public health, and allied disciplines.
- Foster a culture of ethical research conduct, biosafety compliance, scientific integrity, and responsible data management.
- Generate evidence that informs national and global health priorities and policy.

## 5. Objectives

By the end of the program, graduates are expected to be able to:

- Design, conduct, and critically evaluate independent research, applying advanced theoretical knowledge, technical proficiency, and analytical rigor.
- Produce original, valid, and clinically or scientifically meaningful research findings suitable for peer-reviewed publication.
- Apply and, where appropriate, develop innovative approaches in laboratory diagnostics, molecular medicine, biotechnology, and laboratory management.
- Demonstrate competence in research methodology, biostatistics, bioinformatics, quality assurance, and scientific writing.
- Apply research findings to support evidence-based diagnosis, disease prevention, treatment monitoring, and public-health decision-making.
- Communicate research effectively to scientific and non-scientific audiences, and contribute to scientific leadership, collaborative networks, and knowledge translation.

## 6. Research Areas

Candidates can conduct their doctoral research within various advanced domains in Clinical Chemistry, subject to supervisory availability:

- **Biomarker Discovery & Validation:** Identification and clinical validation of novel biomarkers for cardiovascular, renal, oncological, and metabolic liver diseases for early detection, diagnosis, and prognosis.
- **Metabolic & Endocrine Disorders:** Investigating molecular mechanisms of insulin resistance, diabetic vascular complications, metabolic syndrome, atherogenic dyslipidemia, and complex endocrine axis dysfunctions.
- **Point-of-Care Testing (POCT) & Biosensors:** Engineering, analytical validation, and microfluidics integration of portable diagnostic biosensors for rapid bedside and critical care testing.
- **Clinical Toxicology & TDM:** Pharmacokinetic modeling, personalized therapeutic drug monitoring (TDM) for narrow therapeutic index drugs, and mass spectrometry quantification of environmental toxins and heavy metals.

- **Laboratory Quality & Interference:** Systematic characterization of complex analytical interferences (hemolysis, lipemia, icterus) and implementation of Six Sigma metrics and Total Quality Management Systems (TQMS).

## 7. Admission Requirements

- A master's degree in medical laboratory sciences, biomedical sciences, or a related discipline from a recognized university.
- A satisfactory academic record and evidence of research competence.
- English language proficiency, in accordance with University requirements.
- An approved preliminary doctoral research proposal demonstrating originality, feasibility, and potential contribution to knowledge.
- Two academic references, preferably including evidence of research or publication experience.
- Fulfilment of the Faculty of Graduate Studies admission requirements.

## 8. Study Period

The timeline and operational structure for the M.Sc. by Research in Clinical Chemistry are outlined below:

| Parameter | Program Specification |
|---|---|
| Minimum Duration | 3 Years |
| Maximum Duration | 5 Years |
| Mode of Delivery & Language | Full-time research engagement in English |

## 9. General Direction for the Degree

The Doctor of Philosophy by Research degree is conferred primarily based on the execution and completion of an original, independent, and supervised scientific investigation rather than standard structured coursework. Doctoral candidates progress through systematic milestones to maintain scientific rigor, institutional compliance, and academic excellence:

- **Ethical & Biosafety Compliance:** Prior to sample collection, clinical trial enrollment, or laboratory intervention, candidates must secure formal ethical clearance from the Institutional Review Board (IRB) and biosafety approval from relevant institutional safety boards.
- **Progress Monitoring & Seminars:** Candidates undergo continuous academic evaluation through required annual progress reports, mandatory research seminar presentations hosted by the Faculty, and a pre-submission doctoral seminar to assess

thesis readiness.

- **Publication Prerequisite:** Prior to thesis submission, candidates are required to publish (or have accepted for publication) a minimum of two original research articles in indexed, peer-reviewed scientific journals.

## 10. Award of the Degree

The degree of Doctor of Philosophy (Ph.D.) by Research in Medical Laboratory Sciences (Clinical Chemistry) is officially awarded by the Senate of National University – Sudan upon recommendation by the Faculty of Graduate Studies and the Faculty of Medical Laboratory Sciences, subject to:

- **Original Research Execution:** Successful execution and completion of an original, independent doctoral research project demonstrating substantial contribution to scientific knowledge in Clinical Chemistry.
- **Dissertation Submission:** Submission of a final doctoral thesis adhering strictly to university standards on scientific originality, structure, methodology, and academic integrity (Turnitin plagiarism clearance).
- **Oral Examination (Viva Voce):** Successful oral defense (Viva Voce) of the thesis before an officially constituted examination committee comprising internal and external expert examiners.
- **Final Corrections & Library Deposit:** Completion of all mandatory thesis corrections recommended by the examination panel and submission of approved final hardbound copies to the University library.
- **Administrative Clearance:** Fulfillment of all administrative, financial, and institutional obligations to the University.



## 1. Introduction (Background)

The Master of Science (M.Sc.) by Research in Clinical Chemistry is an advanced, research-intensive postgraduate program offered by the Faculty of Medical Laboratory Sciences, National University – Sudan, under the academic supervision and governance of the Faculty of Graduate Studies. The program is specifically structured to address the critical demand for competent, ethical, and independent laboratory scientists and researchers capable of leading diagnostic innovation, conducting high-impact biomedical investigations, and elevating healthcare outcomes in Sudan and the wider region.

Unlike conventional taught master's degrees, this program is entirely research-driven (Degree by Research). Candidates engage directly in supervised, hands-on scientific inquiry rather than attending routine instructional lectures. Guided by experienced academic supervisors and subject matter experts in clinical biochemistry and molecular medicine, students design, execute, and evaluate original research projects aimed at solving real-world diagnostic and clinical challenges.

Throughout their candidature, researchers receive rigorous training in advanced diagnostic methods, biomarker discovery, metabolic and endocrine pathophysiology, point-of-care technology, total laboratory quality management systems (QMS), biosafety, and bioethics. The program culminates in the submission and oral defense of a master's dissertation that meets international standards suitable for publication in peer-reviewed scientific journals.

## 2. Vision

To be recognized as a premier postgraduate program in Clinical Chemistry nationally, regionally, and internationally — distinguished by research excellence, diagnostic innovation, and laboratory quality, while empowering scientific leaders to advance patient care and contribute meaningfully to sustainable national development.

## 3. Mission

To prepare highly qualified, ethical, and innovative clinical biochemists and biomedical researchers through rigorous, mentored research training, state-of-the-art laboratory practice, and interdisciplinary collaboration. In fulfilling this mission, the program is committed to strengthening national diagnostic capacity, addressing local and regional health priorities, and graduating leaders for academia, clinical healthcare, research institutes, regulatory bodies, and the diagnostic industry.

## 4. Goals

- **Advance Research Excellence:** Promote methodologically sound and clinically impactful research in clinical biochemistry and diagnostic sciences.
- **Diagnostic & Clinical Innovation:** Develop evidence-based diagnostic solutions

for metabolic, endocrine, cardiovascular, renal, and hepatic disorders prevalent in the region.

- **Enhance Laboratory Quality Management:** Strengthen research infrastructure and promote total quality management systems (QMS), standardization, and analytical accuracy across laboratory medicine.
- **Foster Interdisciplinary Collaboration:** Bridge clinical chemistry with internal medicine, endocrinology, pharmacology, molecular biology, and biostatistics.
- **Uphold Ethical Standards & Biosafety:** Instill a culture of ethical research conduct, patient data confidentiality, biosafety compliance, and scientific integrity.
- **Support National Health Policies:** Generate scientific evidence that informs national healthcare priorities, disease prevention strategies, and clinical guidelines.

## 5. Objectives

By the end of the program, graduates are expected to demonstrate the capacity to:

- **Methodological Research Design:** Formulate research hypotheses, design rigorous experimental studies, and select appropriate analytical and statistical techniques.
- **Scientific Communication & Publication:** Prepare scholarly dissertations and publish high-quality research findings in peer-reviewed biomedical journals.
- **Technical Proficiency & Validation:** Apply, optimize, and validate novel biochemical assays, automated analyzers, and molecular diagnostic methodologies.
- **Biostatistics & Bioinformatics:** Analyze complex clinical data, master statistical software, and interpret intricate metabolic and biochemical profiles.
- **Evidence-Based Clinical Translation:** Translate laboratory findings into actionable insights for disease diagnosis, prognosis, therapeutic drug monitoring, and patient management.
- **Leadership & Professionalism:** Demonstrate scientific leadership, manage laboratory research teams, and communicate effectively with multidisciplinary healthcare professionals.

## 6. Research Areas

Candidates can conduct their research projects within various advanced domains in Clinical Chemistry, subject to supervision availability:

» **Biomarker Discovery and Validation:**

- Identification and clinical validation of novel cardiovascular biomarkers (e.g., Troponin isoforms, NT-proBNP, inflammatory markers).
- Cancer biomarkers (Tumor Markers) for early detection, prognosis, and therapeutic monitoring.
- Early biomarkers for acute kidney injury (AKI) and chronic kidney disease (CKD)

(e.g., NGAL, Cystatin C).
- Liver function markers and biochemical indicators of metabolic liver disease and fibrosis.

» **Metabolic and Endocrine Disorders:**
- Biochemical pathways of diabetes mellitus, insulin resistance, and vascular/glycation complications.
- Metabolic syndrome, dyslipidemia, and atherogenic lipid profiles.
- Thyroid, adrenal, pituitary, and reproductive hormone dysfunctions.

» **Point-of-Care Testing (POCT) & Rapid Diagnostics:**
- Development, evaluation, and quality assurance of portable diagnostic devices and microfluidic sensors.
- Analytical validation and clinical accuracy comparison between POCT devices and central laboratory analyzers in emergency and critical care settings.

» **Clinical Toxicology and Therapeutic Drug Monitoring (TDM):**
- Pharmacokinetics and therapeutic drug monitoring of narrow therapeutic index drugs to optimize dosing and prevent toxicity.
- Screening and quantification of environmental toxins, heavy metals, and chemical drugs.

» **Laboratory Quality & Analytical Validation:**
- Investigation of analytical interferences (e.g., hemolysis, icterus, lipemia, heterophile antibodies).
- Implementation and assessment of Internal Quality Control (IQC) and External Quality Assurance (EQA) schemes in automated clinical chemistry laboratories..

## 7. Admission Requirements

- **Bachelor's Degree:** A Bachelor of Science (B.Sc.) degree in Medical Laboratory Sciences (specializing in Clinical Chemistry) or a closely related biomedical discipline from National University – Sudan or any recognized institution, with a satisfactory academic standing.
- **Academic Transcript:** An official academic transcript demonstrating adequate preparation in clinical biochemistry, metabolic medicine, and laboratory techniques.
- **English Language Proficiency:** Demonstrated proficiency in English (the language of instruction, research, and thesis defense) as required by University regulations.
- **Preliminary Research Proposal:** Submission of an approved research concept note or preliminary proposal aligned with the department's active research lines and supervisory capacity.
- **Academic References:** Two confidential academic/professional reference letters

testifying to the applicant's research capacity and academic competence.

- **Graduate Studies Approval:** Fulfillment of all general admission requirements set by the Faculty of Graduate Studies.

## 8. Study Period

The timeline and operational structure for the M.Sc. by Research in Clinical Chemistry are outlined below:

| Parameter | Program Specification |
|---|---|
| Minimum Duration | 2 Years |
| Maximum Duration | 4 Years |
| Mode of Delivery & Language | Full-time research engagement in English |

## 9. General Direction for the Degree

The Master of Science by Research is conferred primarily based on the execution and completion of an original, supervised investigation rather than standard structured coursework. Candidates progress through systematic milestones to maintain scientific rigor, institutional compliance, and academic excellence:

- **Ethical & Biosafety Compliance:** Prior to sample or data collection, candidates must secure formal ethical and biosafety clearances from relevant institutional review boards.
- **Progress Monitoring:** Candidates undergo continuous evaluation through required annual progress reports and a pre-submission seminar organized by the Faculty.

## 10. Award of the Degree

The Master of Science (M.Sc.) by Research in Clinical Chemistry is officially awarded by the Senate of National University – Sudan upon recommendation by the Faculty of Graduate Studies and the Faculty of Medical Laboratory Sciences, subject to:

- **Original Research Execution:** Successful completion of an independent research project of appropriate scope and rigor.
- **Dissertation Submission:** Submission of a dissertation satisfying university regulations regarding originality, methodology, and scientific structure.
- **Oral Examination (Viva Voce):** Successful defense of the dissertation before an approved examination committee comprising internal and external examiners.
- **Final Corrections:** Completion of all mandatory corrections recommended by the examination panel and submission of approved final hardbound copies.
- **Administrative Clearance:** Fulfillment of all administrative, financial, and institutional obligations.