

THE ROLE OF CLINICAL CHEMISTRY

OF COMMUNICABLE AND NON-COMMUNICABLE DISEASES IN THE CONTEXT OF ONE HEALTH

EDWARD R KABYEMELA/ G. MWAKISAMBWE -0715447465 SCHOOL OF DIAGNOSTIC MEDICINE - MUHAS

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OUTLINE OF PRESENTATION

INTRODUCTION
 CLINICAL CHEMISTRY
 NCD
 BIOSURVELLANCE
 ONE HEALTH

CLINICAL CHEMISTRY IN CD AND NCD

- 1. COVID 19
- 2. LEPTOSPIROSIS
- **3. OBESITY (DM, CVD, CANCER)**

CONTEMPORARY ISSUES IN DISEASE BIOMARKERS ✓ THE ERA OF "OMICS"





BIOSURVEILLANCE



Continuous monitoring and analysis of health data to detect and respond to emerging threats









- ✓ A collaborative, multi-sectoral, and transdisciplinary approach.
- ✓ Local, regional, national, and global levels
- ✓ Goal: OF ACHIEVING OPTIMAL HEALTH OUTCOMES.
- Recognizing the interconnection between PEOPLE, ANIMALS, PLANTS, and their shared ENVIRONMENT.



CLINICAL CHEMISTRY IN SURVEILLANCE AND CONTOL OF DISEASES IN ONE HEALTH APPORACH

- Pivotal role in both CD and NCD Provides a comprehensive understanding of:
- ✓ Disease patterns
- ✓ Risk factors
- ✓ Disease impact across these interconnected domains.
- Elaboration using examples of COVID 19, LEPTOSPIROSIS AND OBESITY.





CLINICAL CHEMISTRY IN ONE HEALTH FRAMEWORK: THE CASE OF COVID-19



- Monitoring Disease Progression:
- ✓ Specific biomarkers (CRP, D-dimer, Procalcitonin)
- ✓IL-6 and ferritin (hyperinflammatory response, cytokine storm).
- Assessing Organ Function:
- ✓LFT (AST, ALAT), RFT (Creatinine) severe cases can lead to organ dysfunction.
- Assesses electrolyte levels, aiding in treatment decisions.
- Vaccine development (safety trials e.g. LFT)

In summary:

- Clinical chemistry is indispensable in monitoring and management of COVID-19.
- ✓ Aids in individual patient care
- ✓ Contributes to our collective understanding of the virus

 ✓ Informs public health policies, and supports global efforts to combat the pandemic

CLINICAL CHEMISTRY IN ONE HEALTH FRAMEWORK: THE CASE OF LEPTOSPIROSIS

- ✓ Bacterial
- ✓ Humans and animals
- ✓ Wide range of symptoms
- ✓ Dogs,
 rodents, and
 farm animals
- ✓ Cariers
- ✓ Excreta:
 Urine

HUMAN PATIENT

CLINICAL CHEMISTRY BIOMARKERS LFT (ASAT, ALAT) RFT (CREAT, BUN) ELECTROLYTE (Na. K ✓ SEVERITY OF DISEASE ✓ ORGAN INVOLVEMENT





Zoonotic Diseases - A One Health Perspective:



Summary: In Leptospirosis Clinical Chemistry provides: ✓ Early diagnosis ✓ Disease monitoring In order to: Prevent severe complications like organ failure and death.



CLINICAL CHEMISTRY IN THE ONE HEALTH FRAMEWORK: THE CASE OF OBESITY

- Clinical chemistry plays a significant role in biosurveilance and the control of obesity in both humans and animals.
- It encompasses a range of laboratory tests and analytical techniques that provide valuable insights into the metabolic and pathological changes associated with obesity

1. Metabolic Profiling:

 Insulin resistance, which is a key factor in obesityrelated conditions like type 2 diabetes- tailor treatment strategies

2. Nutritional Assessment:

- Identifying nutrient deficiencies or imbalances contributing to obesity.
- Help design appropriate dietary interventions (Animals).

3. Monitoring Obesity-Related Health Conditions:

- Dyslipidemia, hypertension, and fatty liver disease.
- Early intervention and disease management.
- 4. Organ Function Testing:
 - Obesity often leads to non-alcoholic fatty liver disease (NAFLD), (e.g. ALT (alanine aminotransferase) and AST (aspartate aminotransferase).

4. Endocrine Profiling:

- Hormonal imbalances are common in obesity, and clinical chemistry assays measure hormones like leptin, adiponectin, and insulin.
- This aids in understanding the hormonal regulation of body weight.

5. Inflammation Markers:

- Obesity is associated with chronic inflammation. Clinical chemistry assesses markers like C-reactive protein (CRP) to gauge inflammation levels.
- Controlling inflammation is crucial in obesity management.

6. Treatment Evaluation:

• Monitoring of the effectiveness of obesity treatments (e.g. modifications)

6. Veterinary Applications:

- In veterinary medicine, clinical chemistry aids in diagnosing and managing obesity in animals, ensuring their overall health and well-being.
- Similar biomarkers and assays apply to animals as in human clinical chemistry.

One Health Collaboration:

- Clinical chemists collaborate with healthcare providers, veterinarians, and researchers to share data and insights on obesity.
- This interdisciplinary approach aligns with the One Health framework.

CONTEMPORARY ADVANCES IN DISEASE BIOMARKER DISCOVERY

"OMICS"

- Omics refers to a <u>comprehensive</u> and <u>large-</u> <u>scale</u> study of biological molecules or systems.
- It encompasses various disciplines, such as GENOMICS, EPIGENOMICS TRANSCRIPTOMICS, PROTEOMICS AND, , METABOLOMICS, among others.
- Omics technologies have played a significant role in disease biomarker discovery and the understanding of diseases (DM, CVD, CANCER).

OMICS AT A GLANCE



OMICS IN BIOMARKER DISCOVERY: A CASE OF OBESITY

- Obesity: Growing global public health crisis
- Linked (T2 DM, CVD, certain CANCERS).
- Etiology: Complex nature: gene-environment interactions, hormonal, metabolic, neurochemical, and immune-inflammatory disturbances.
- "Omics" technologies: Understanding the biology, identifying biomarkers, and enabling precision prevention and therapy for OBESITY.

1: GENOMICS

- Genetic origins: (1970s): 40 to 70%.
- Mutations leptin-melanocortin pathway
- Advances: DNA microarrays and NGS
- GWASs: hundreds of genetic variants
- 2.1 million common genetic variants: Predicting obesity and weight gain.
- Targeted prevention in high-risk individuals.

2: EPIGENOMICS

- DNA modifications (e.g., DNA methylation), histone modifications, and non-coding RNAs
- EWAS have linked DNA methylation patterns to obesity and related traits
- Advanced techniques like CHIP sequencing :
- Histone modification: Linked H3K4me3 enrichment to higher BMI
- Evaluate histone modification biomarkers in obesity research.

3:TRANSCRIPTOMICS

- Bridge the gap between GWAS and physiological studies.
- Biomarkers include mRNAs and ncRNAs
- RNA sequencing , gene arrays.
- Tissue-specific mRNA in adipocytes: > a thousand genes altered in obese vs. lean individuals.
- miRNAs play roles in adipogenesis, adipocyte differentiation, and insulin signaling:
- Differentially expressed in obese adipose tissue.

4:PROTEOMICS

- Statistically significant associations with BMI for various biomarkers.
- Complement factors (B, H, I,) and CRP)
- CRP: Strongest association with BMI and was linked to all identified biomarkers.
- Obesity: a state of chronic inflammation.

4:METABOLOMICS

 \checkmark Lipids, amino acids, peptides, organic acids, and carbohydrates. ✓ Nuclear magnetic resonance (NMR) spectroscopy or mass spectrometry (MS). ✓ Untargeted/Untargeted. ✓ High levels of BCAA and aromatic amino acids have been associated

with insulin resistance and an increased risk of type 2 diabetes.

4:LIPIDOMICS

- Fatty acyls, glycerolipids, glycerophospholipids, sphingolipids, sterols, and prenols.
- Targeted/Untargeted
- Advances in mass spectrometry (MS).
- High-fiber diets: alterations in the metabolic profiles of phospholipids in obese individuals
- Application of lipidomics in obesity prevention strategies.

"OMICS"

✓Omics data complex

- Meaningful use OF DATA: Bioinformatics and statistical data ANALYSIS:
- ✓ Integrated multi-omics approaches: Better understand complex biological systems
- ✓ Challenges: Bias from differences in study designs, sample collection, measurements, and data analysis methods

WAY FORWARD: Strong study design, precise laboratory work, and validated research hypotheses

Clinical chemistry serves as a fundamental tool in the biosurveilance and control of DISEASES in both humans and animals within the One Health paradigm.

It enables <u>early diagnosis</u>, <u>metabolic profiling</u>, <u>monitoring of related health conditions</u>, and the <u>assessment of treatment efficacy</u>.

By fostering collaboration among physicians, veterinarians, and researchers, CLINICAL CHEMISTRY contributes to a comprehensive understanding of CD and NCD and their management across species.

THANK YOU FOR YOUR ATTENTION