Clinical Laboratory Diagnostics

Dr LiQingrong
College of Life Science and Laboratory Medicine KMU

- Introdution



SUPERCOURSE, CHINA

Exam

- 1、Homework
- 2、Analysis of simple report



SUPERCOURSE, CHINA

01

What Is Laboratory Diagnostics

Behind every diagnosis lies a laboratory result
Defining the discipline and its role in medicine



WHAT IS IT?

Pathology?
Clinical Laboratory Diagnostics?



SUPERCOURSE, CHINA


医学检验科
Medical Laboratory
5
急诊
4
采血
3
采血
2
采血
1
刷卡处
温馨提示
请自觉排队

A Pillar of Modern Medicine

Nearly every clinical decision leans on a laboratory result

Four key pillars guide lab medicine — **early detection**, confirmation, tracking, and long-term follow-up.

Prevention

Early Detection

Guides screening in people who have **no symptoms yet**

Diagnosis

Diagnosis

Confirms or rules out suspected conditions **before treatment begins**

Monitoring

Monitoring

Tracks disease progression and response to therapy **over time**

Prognosis

Prognosis

Supports long term follow up **after recovery**

Six Faces of One Discipline

Sub-discipline	Main Focus
Clinical Chemistry	Chemical composition of blood and fluids
Hematology	Blood cells and coagulation
Microbiology	Bacteria, viruses and fungi
Immunology	Immune response and antibodies
Molecular Diagnostics	DNA and RNA analysis
Urinalysis	Urine and body fluid screening
Each sub-discipline answers different clinical questions with its own tools	

From Order to Report

1

Order

Clinicians prescribe appropriate laboratory tests for clinical conditions.

2

Collect

Specimens are collected and marked at the patient’ s bedside

3

Transport

Specimens are transported and registered in the

4

Measure

Specimens are measured using specific methods

5

Report

Results are reviewed, interpreted and reported back to clinicians.

What is it

Laboratory and diagnostic tests are tools to gain additional information about the patient.

These tests are not therapeutic; however, when used in conjunction with a thorough history and physical examination, these tests may confirm a diagnosis or provide valuable information about a patient's status and response to therapy that may not be apparent from the history and physical examination alone.



SUPERCOURSE, CHINA

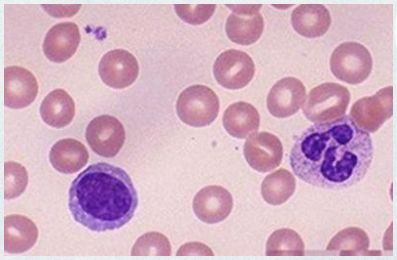
IN THE LAB





Hematological test

Blood Studies
Urine Studies
Stool Studies



01

02

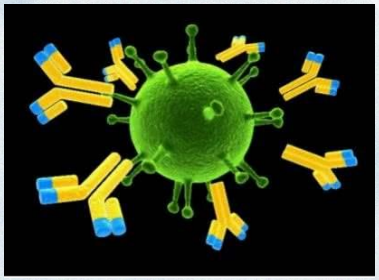
Biochemical test



The Clinical lab examiation in Virus Diagnosis

Immunological test

03



04

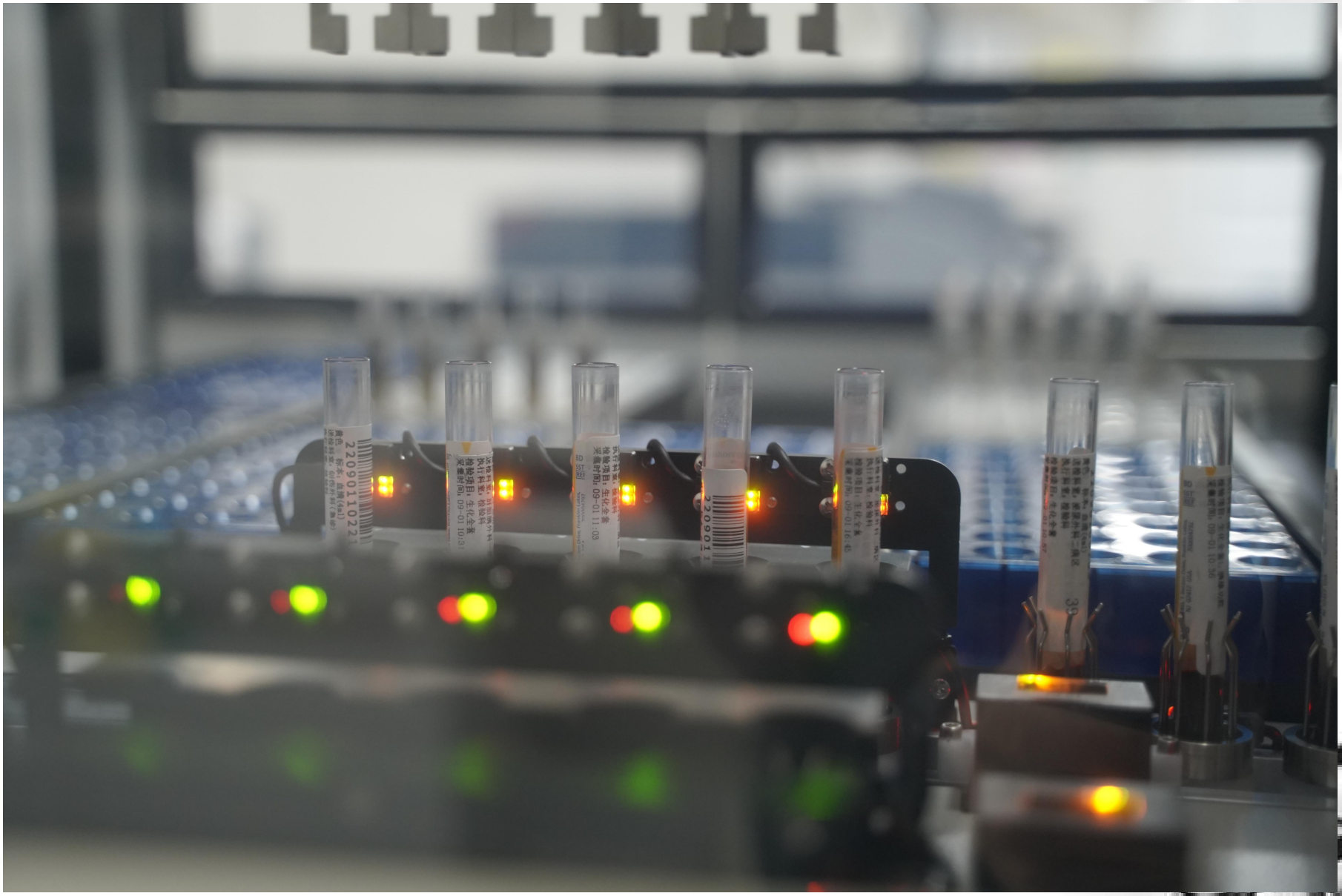
Molecular diagnostics




sysmex
sysmex
UF-5000








BECKMAN COULTER
AU5800

Specimen collection

Specimens can be rejected for analysis because of factors related to the specimen itself or to the collection process



02

Core Testing Principles

Every result begins with a well-collected specimen
Methods, analyzers and analytical technologies



Good Specimens Make Good Results

The specimen is the raw material of diagnosis — its quality sets the ceiling



Patient Preparation

Fasting state, timing and medication can **shift results**.

Collection Technique

Influences **hemolysis, clotting and contamination**.

Labeling and Transport

Errors are a **leading cause of rejected samples**.

How Analyzers Detect Disease

Different questions call for different measurement technologies

Method	How It Works
Spectrophotometry	Measures light absorbed by a colored reaction
Immunoassay	Uses antibodies to detect specific molecules
Chromatography	Separates components of a mixture
Microscopy	Direct visual examination of cells
Electrochemistry	Measures ions through electrical signals

不同问题需要不同检测技术

Automation Drives Reliability



- Modern labs process **thousands of tests per day** with automated analyzers
- Automation reduces **hands-on variation** and improves reproducibility
- Bar codes, robotics, and software **track every sample** end to end
- Technologists shift from manual work to **reviewing and troubleshooting**

Molecular Testing Reads DNA

Molecular diagnostics moves laboratory testing from whole organisms to the genetic level

Detects Genetic Material

Identifies **DNA or RNA** instead of whole organisms

PCR Amplification

Amplifies **tiny amounts of DNA** for detection

Sequencing

Reads the **exact order of bases** in a gene

Clinical Applications

Infectious disease, cancer genetics and inherited disorders

High sensitivity allows detection even when **few targets are present**

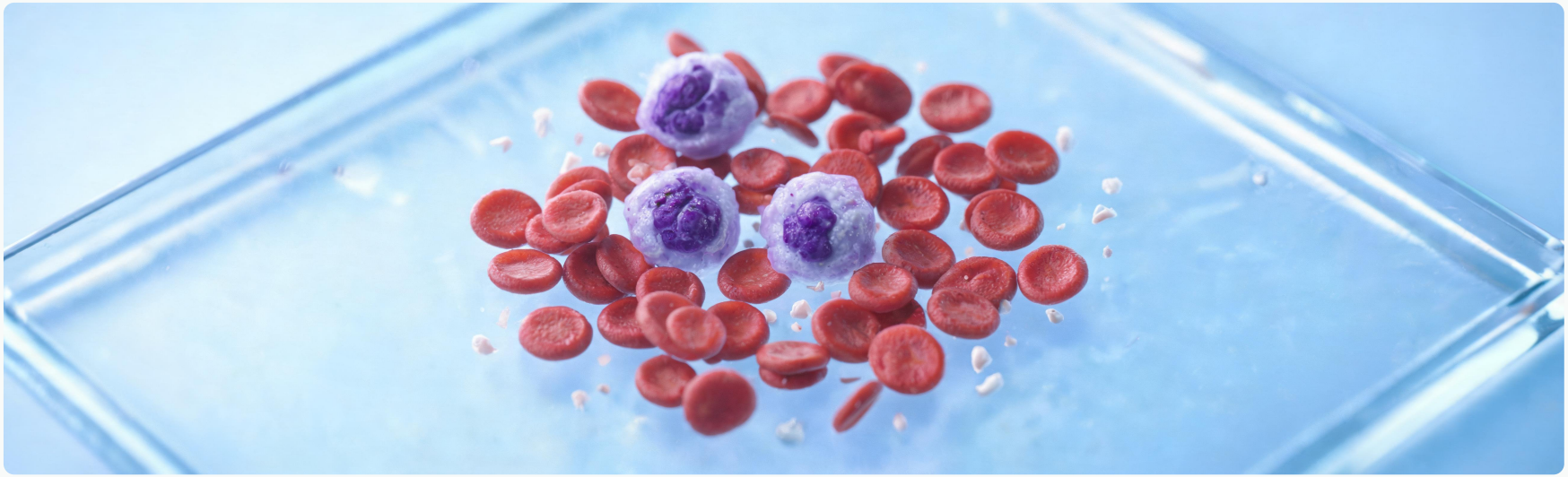
03

Clinical Application

Tests turn symptoms into evidence
Applying laboratory tests across organ systems



Blood Tells Its Own Story



A complete blood count is one of the **most common laboratory tests worldwide**

What the Test Reveals

- Counts and sizes of **red cells, white cells and platelets** are measured
- Abnormal counts can point to **anemia, infection or bleeding disorders**
- **Coagulation tests** assess how well blood clots

Chemistry Screens the Body

生化检验结果反映**器官功能**与**代谢状态** Biochemical test results reflect organ function and metabolic status.

Organ Health

肝脏和肾脏面板揭示器官健康与过滤能力
Liver and kidney panels reveal organ health and filtration capacity

Metabolic Risk

葡萄糖和脂质评估代谢和心血管风险
Glucose and lipid profiles assess metabolic and cardiovascular risks

Fluid Balance

电解质和血气监测酸碱与体液平衡
Electrolytes and blood gases monitor acid-base and fluid balance.

Tissue Damage

心肌标志物等酶类信号提示组织损伤
Cardiac markers and enzymatic signals indicate tissue injury.

Immunity Reveals Infection

抗体与抗原检测是**识别感染**的窗口Antibody and antigen tests serve as a window to identify infections.

抗体检测

间接证据 反映**过去或现在**的感染暴露 They reflect past or current infectious exposure.

血清学 适用于**免疫状态**与**疫苗应答**追踪They are suitable for tracking immune status and vaccine response.

抗原检测

直接证据 **直接**检测病原体产生的分子 They directly detect molecules produced by pathogens.

病原体 用于**自身免疫性疾病**识别They are used for the identification of autoimmune diseases

Markers Signal Hidden Tumors

Tumor markers **support** diagnosis, they do not **replace** it

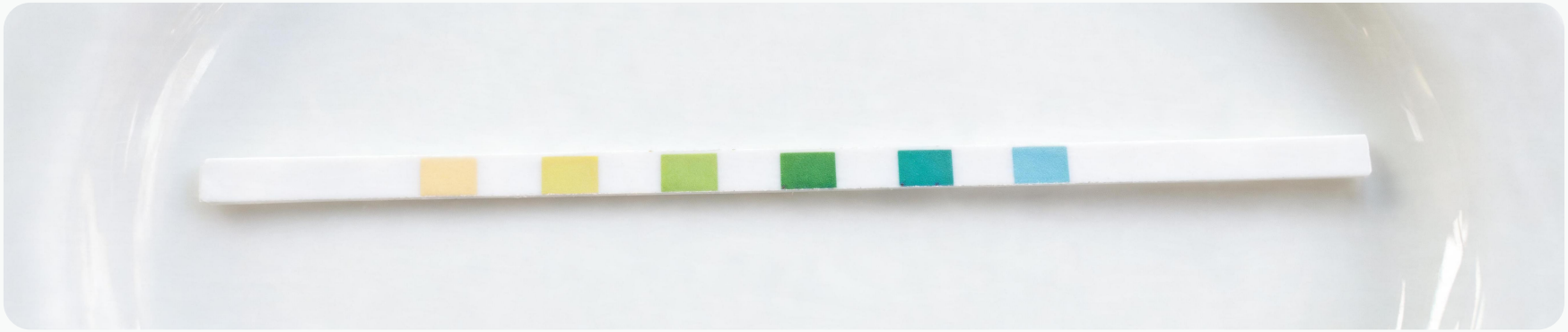
Tumor Markers

1. Substances that may **rise** when cancer is present
2. Include **proteins** and **hormones** released by tumor cells
3. Help **monitor treatment** and **detect recurrence**

Molecular Testing & Interpretation

1. Identify **mutations** that guide **targeted therapy**
2. A **single marker** is rarely enough
3. Results need **clinical** and **imaging context**

Urine and Fluids Speak Volumes



Sample Analysis Overview

Urinalysis	quick, low cost test with **broad screening value**
Chemical strips	check for **glucose, protein, blood** and infection markers
Microscopy	examines **cells, crystals and casts** in the sediment
Body fluid analysis	helps evaluate **infection and bleeding** in joints or cavities

04

Result Interpretation

A number means nothing without context
Reading results and recognizing pitfalls



Reference Ranges Are Not Rules

参考区间来自**群体统计**，而非**个体规则**Reference intervals are derived from population statistics, not individual criteria.

群体基准，不是个体规则Population-based Reference, Not Individual Criteria

- 参考区间由健康人群数据构建，**不是**来自单一患者
  Reference intervals are established from data of healthy populations, not from individual patients.
- 超出范围的结果会被标记，但**标记不等于诊断**
  Results outside the interval will be flagged, yet flagging does not equal diagnosis.

个体差异，趋势优先Individual Variation, Trend First

- 年龄、性别、妊娠与饮食均可改变预期值Age, gender, pregnancy and diet may all alter expected values
- 略超范围的结果对特定个体仍可能正常Results slightly outside the interval may still be normal for a specific individual.
- 多次测量的**变化趋势**往往比单次数值更重要Trends from repeated measurements are often more important than single values

- 参考区间来自健康人群的统计分布，而非某个患者的个体标准
  Reference intervals are derived from the statistical distribution of healthy populations rather than individual standards for a single patient.

Sensitivity Meets Specificity

Two properties decide how **useful** a test really is

Sensitivity

2 项

Detects disease when present

It finds disease when it **is present**

Avoids false negatives

Focuses on avoiding **false negatives**

Specificity

2 项

Rules out disease when absent

It rules out disease when it **is absent**

Avoids false positives

Focuses on avoiding **false positives**

When Results Mislead

Not every abnormal result reflects real disease

Pre-analytical

Wrong collection or storage

Analytical

Instrument or reagent problem

Post-analytical

Transcription or reporting mistake

Biological

Natural variation within a person

Interference

Another substance distorts the reading

Numbers Need Clinical Context

A result becomes meaningful only when paired with the patient story

Numbers are only the start — **clinical meaning** comes from context and conversation.

Combine with Clinical Picture

Combine laboratory data with **symptoms, history and examination**.

Confirm Unexpected Findings

Use **repeat testing** to confirm unexpected findings.

Communicate with the Laboratory

Communicate with the laboratory when results **do not fit the clinical picture**.

Interpret as a Conversation

The best interpretation is **a conversation, not a single number**.

05

Quality and Safety

Reliable results are built, not assumed
Quality control, biosafety and standardization



Quality Is Built Not Assumed

Internal Quality Control

Runs known samples daily to detect drift

Control Limits

Control values must fall within defined limits before patient tests are released

Calibration

Keeps instruments aligned to true values

Documentation

Creates a traceable record for every result

Reliable results come from **deliberate, continuous quality control**

Peer Review Keeps Labs Honest

External evaluation and standardization keep results consistent across laboratories

Proficiency Testing

The same sample is sent to **many labs** for comparison

ISO 15189 Accreditation

Verifies **technical competence** against international standards

Standardization

Lets results **travel** between hospitals and countries

Regular Audits

Find problems **before they reach patients**

Safety Protects Staff and Samples



安全防护要点

4 条核心规范

- Treat every specimen　视所有标本为潜在感染源
- PPE and hand hygiene　个人防护装备与手卫生可阻断暴露
- Handle sharps with care　谨慎处理锐器并投入指定容器
- Proper storage and tracking　规范存储与追踪保护人员与标本完整

06

Future of Diagnostics

The lab of tomorrow starts with what you learn today
Precision medicine and the intelligent laboratory



Precision Medicine Starts Here

The future of medicine is tailored to the individual, and labs lead the way

From **genetic profiling** to **companion diagnostics** — four pathways bring precision medicine into routine lab practice.

精准医学的四个落地路径

- **Genetic and molecular profiles** guide drug selection and dosage
- **Biomarkers** help predict who will respond to a treatment

基因图谱 生物标志物

- **Companion diagnostics** pair a test with a specific therapy
- Testing moves from **one size fits all** toward **one patient at a time**

伴随诊断 个体化治疗

AI Reshapes the Laboratory

Digital tools are changing how laboratories work

AI is transforming laboratory workflows by **flagging anomalies, supporting image analysis, linking data, and automating routine tasks.**

智能化技术趋势



Artificial intelligence

flags abnormal patterns and prioritizes urgent cases

AI



Machine learning

supports image analysis of cells and slides

机器学习



Big data

links results across time and populations

大数据



Automation & software

reduce routine workload for skilled staff

自动化

Testing Moves to the Bedside



Point of care testing brings results directly to the patient

快回报 Faster turnaround **supports rapid clinical decisions**

便携 Devices are smaller, simpler and **usable outside the main lab**

质量与安全 **Quality and safety** still matter wherever testing happens

The Future Professional

Tomorrow laboratory professionals need more than technical skill

Tomorrow's laboratory professional is a **clinical partner**, not just a technician

技术与临床融合

Combine **laboratory expertise** with clinical understanding

融合

保持技术好奇

Stay curious about **new technologies** and methods

好奇

清晰沟通协作

Communicate clearly with **clinicians and patients**

沟通

以患者为中心

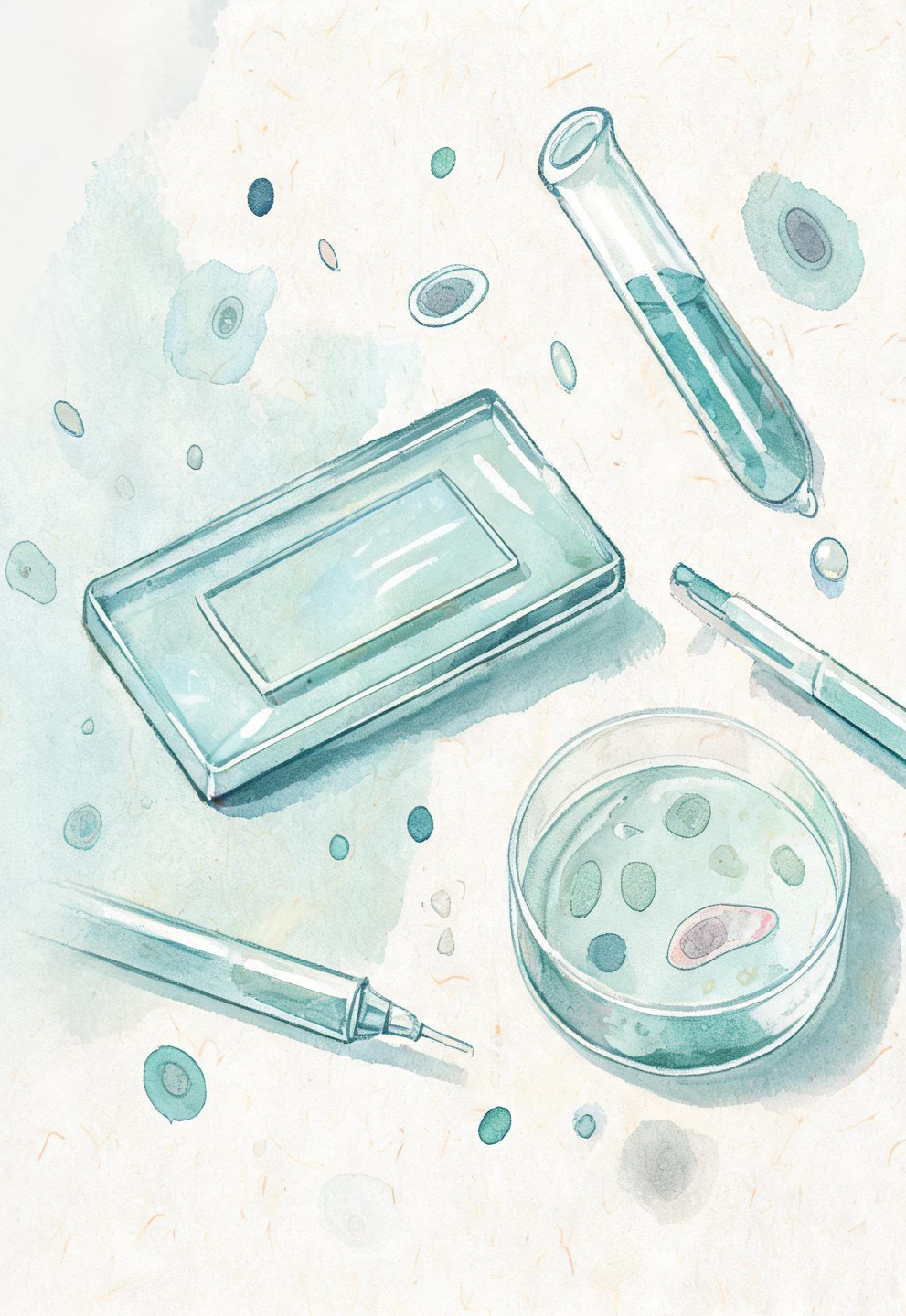
Every result you produce shapes a **real person's care**

患者

Good medicine begins with good laboratory science

From Specimen to Diagnosis

Master the principles, and every result becomes a story you can read



1. Stool and urine collection requires clean, dry containers and kits.
2. Timed urine collection requires refrigeration or containers with special additives.
3. Sterile, dry containers and special kits are needed for midstream clean-catch urine specimens.
4. Oral, saliva, and sputum specimens require specific techniques and kits and, sometimes, special
preservatives.
5. Blood collection equipment includes gloves, needles, collection tubes, syringes, tourniquets, needle disposal containers, lancets for skin puncture, cleansing agents or antimicrobial skin preparations, and adhesive bandages.
6. Color-coded stoppers and tubes indicate the type of additive present in the collection tube
7. Additives preserve the specimen, prevent deterioration and coagulation, or block action of certain enzymes in blood cells.



SUPERCOURSE, CHINA

8. Tubes with anticoagulants should be gently and completely inverted (end over end) 7 to 10 times after collection. This process ensures complete mixing of anticoagulants with the blood sample and prevents clot formation.

9. Store specimens properly after collecting or transport them to the laboratory immediately for processing and analysis if possible. Failure to do so may result in specimen deterioration. STATordered tests should always be hand-delivered to the laboratory and then processed as STAT.

10. Unacceptable specimens lead to increased costs and time wasted in getting results to the clini_x0002_cian, patient, institution, and third-party payer. Exposure to sunlight, air, or other substances and warming or cooling can alter specimen integrity. Check with the laboratory for proper storage
(e.g., ice, ice water, separate from ice), transport, and time limits.

11. As environments for specimen collection become more variable, modified procedures and proto_x0002_cols require the clinician to keep abreast of the latest information related to these factors.



SUPERCOURSE, CHINA

Three important test

1、Blood test
2、Stool test
3、Urine test



SUPERCOURSE, CHINA

1、What is look like
2、Mucus in Stool
3、Leukocytes in Stool
4、RBC in Stool
5、Fat in Stool
6、Meat Fibers in Stool
7、Parasite in stool



SUPERCOURSE, CHINA