



醫檢師的過去現在與未來

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檢驗醫學

- Laboratory analysis was intended to confirm a tentative diagnosis based on clinical or radiological information.
- Laboratory studies serve to **provide diagnoses**, to **detect increased risks of disease**, **clinical responsibilities**, **the progress of therapy** (decrease in signs of infection or decline in tumor markers) and **early detection of side effects and complications** (monitoring of liver and kidney parameters during chemotherapy).





檢驗醫學

- Laboratory medicine is a relatively young medical science.
- Its foundations were laid in the 19th century.
- It was only in the 1930s that it began to develop as a clinical discipline.



- ◆ In the 20th century phlebotomy was introduced as a diagnostic tool
- ◆ Prior to that it was considered to be curative
- ◆ Venipuncture is in widespread by 1920.



檢驗儀器: 1920

A modern 200-300 bed hospital in the USA would be well equipped if it had

- ◆ A balance
- ◆ A microscope
- ◆ A centrifuge
- ◆ A Bunsen burner
- ◆ A Duboscq colorimeter



臨床生化儀器

- 1950 手工檢驗 (玻璃年代)
- 1965 半自動檢驗

Continuous flow

Discrete system

Centrifugal analyzer system

Thin-film analyzer system

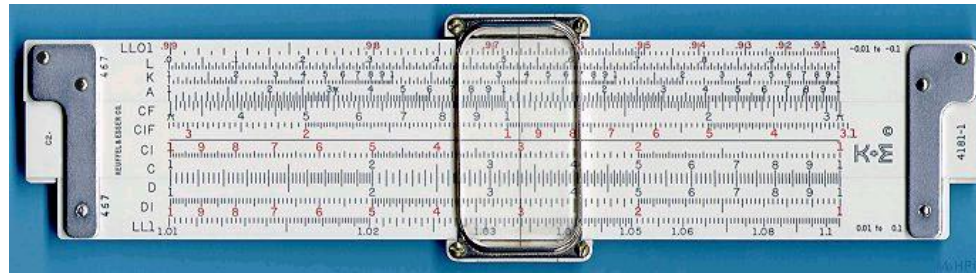
Ion selective electrode analyzer system





Technicon SMA autoanalyzer (1970)

- ◆ There were no calculators. Slide rules were used!
- ◆ No automation
- ◆ No sophisticated quality control
- ◆ No fax machines
- ◆ No laboratory information systems



Hematology

- 手工計數Hemocytometer
- 1956 半自動電阻
- 1968 Coulter血球分類
 - Pattern recognition
 - Flow cytometry



資訊系統

- 1983 LIS
- 1997
- Sample automation
- Analytical automation
- Data processing automation
- 2006

Total laboratory automation (TLA)

檢驗室之過去



A 3D rendering of a large, white, modular industrial machine, likely a textile loom or weaving machine. The machine is composed of several interconnected sections. On the left, there is a control panel with a small screen and buttons. The main body of the machine features multiple large, rectangular hoppers or bobbins, each with a red and green indicator light. The machine is mounted on a white base with wheels. The background is a plain, light blue surface.

Input Output Module, Centrifuge Module, Decapper Module,
Instrumentation (2 Clinical Chemistry, 2 Immunoassay).

醫技人員

- 1918, John Kolmer published “The Demand for and Training of Laboratory Technicians,” which included a description of the first formal training course in medical technology.
- By 1920, clinical laboratories in large hospitals were distinct administrative units of service. They usually consisted of four or five divisions, including biochemistry, clinical pathology, bacteriology, serology/immunology and radiology.



台灣醫事技術學系的緣起

- 用以診斷病症之病理、細菌、血清、生化、生理、X光等各部門檢驗，以往多由醫師自己去做，後來所需各種檢驗越來越多且又複雜，致使醫師研究診斷及治療的時間大為減少，影響其工作至鉅，因此開辦短期訓練班訓練技術員。
- 美國國際合作署中國安全分署醫學教育顧問杜克大學醫學院院長Dr. Davison建議台大醫學院，設立醫技系以培養檢驗技術員。





醫事技術學系的創建

- 45年 台大醫技系
- 54年 北醫、元培、輔英醫技科
- 55年 中山、中台醫技科
- 58年 中華醫技科
- 68年 陽明醫技系
- 70年 高醫、中國醫技系
- 78年 成大、長庚醫技系
- 83年 慈濟醫技系





醫學技術學系

- 共同必修課程
- 基礎醫學課程
- 臨床專業課程
- 醫院實習課程

Laboratory experiment
Clinical practice





檢驗醫學之臨床需求

- 實驗室品管
- 檢驗流程
- 檢驗效益
- 法規倫理
- 實驗室管理
- 認證評鑑

學校 實習 臨床





現階段檢驗醫學

- ◆ Point-of-Care Testing
- ◆ Molecular diagnostics
- ◆ Consolidation of testing on a single platform
- ◆ Consolidation of reference laboratories
- ◆ Sophisticated equipments
(Tandem Mass Spectrometry)



MALDI TOF/TOF MS



AutoFlex



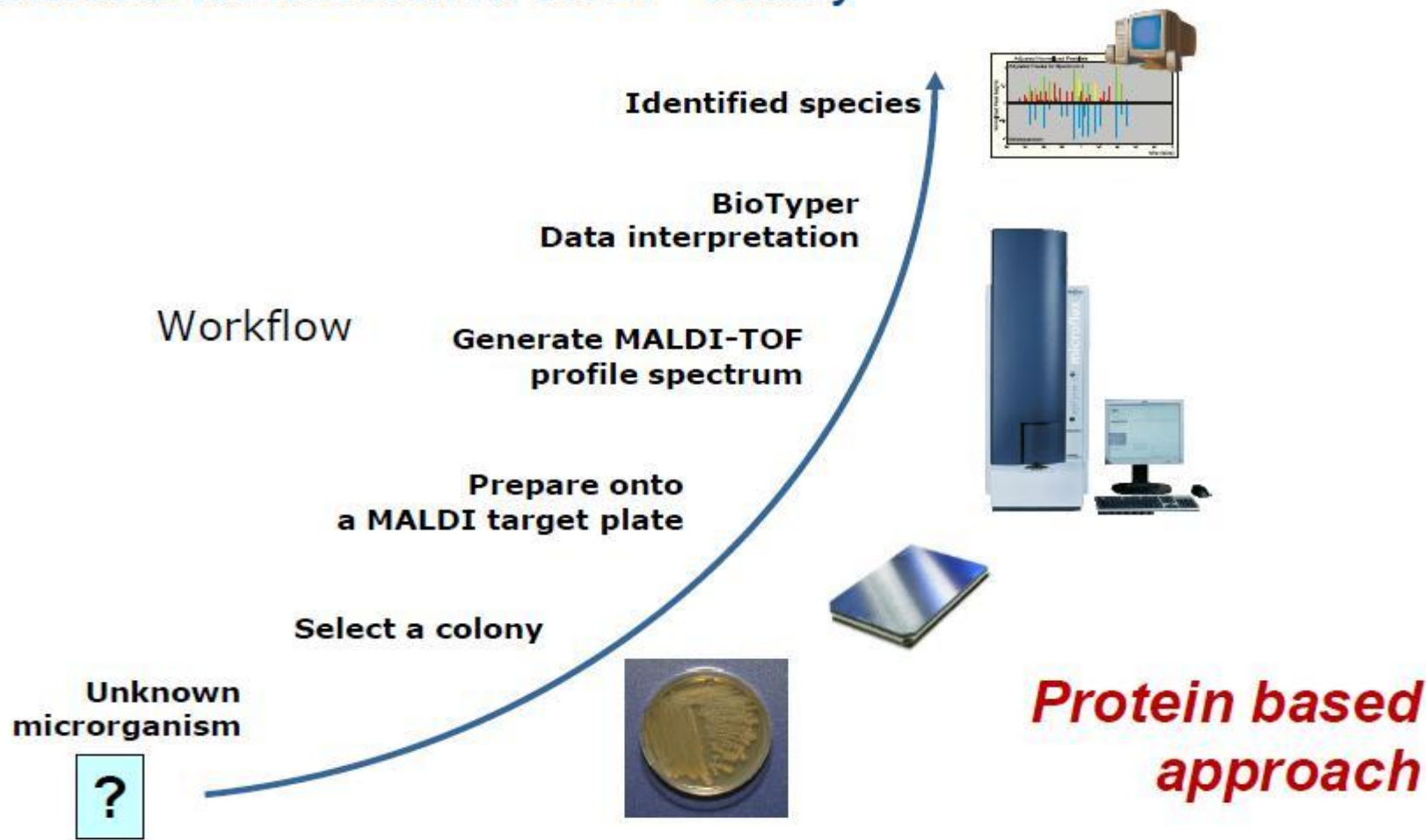
MicroFlex



Bruker Daltonics

MALDI Biotyper

Microbial Identification for the 21st Century





分子診斷

- **Cytogenetics:** the study of all aspects of cytology, including the structure of chromosomal material, involves a broad and in-depth analysis of hereditary information derived from chromosomal materials.
- **Flow cytometry:** Flow cytometry is a technique for counting, examining, and sorting microscopic particles suspended in a stream of fluid.
- **Molecular genetics:** The field of molecular-genetics has evolved from a few scientists and researchers just 30 years ago.
- **HLA/immunogenetics:** The human leukocyte antigen system (HLA) is the name of the human major histocompatibility complex (MHC), a group of genes that resides on chromosome 6 and encodes cell-surface antigen-presenting proteins and many other genes.





分子診斷未來的發展

- 感染性疾病的偵測
- 腫瘤的診斷與偵測





個人化檢驗醫學

The shift from the use of **traditional diagnostics and treatment** to delivering **personalized medicine** based on “omics” techniques may translate into early diagnoses and tailored treatments of human diseases.

Proteomics
Pharmacogenomics
Physiogenomics
Nutrigenomics





GENOME-WIDE ASSOCIATION STUDIES

- Collecting DNA samples from populations whose clinical characteristics are well defined.
- Doing cost effective genotyping and sophisticated statistical analysis.
- These resources represent an essential component in establishing genes relevant to a particular disease.

Genetics----Diseases



檢驗資訊

- **IT needs to be the backbone of healthcare**
- **It can lead to a better understanding of unnecessary tests**
- **It allows the development of evidence-based protocols**
- **Leads to an understanding of the “best” laboratory tests for the diagnosis of disease**



檢驗醫學的未來

- In the era of molecular medicine, more and more diagnoses will be made by laboratory tests in **asymptomatic patients**.
- The goal is to make the diagnosis before clinical signs or symptoms resulting from organ damage become evident





檢驗醫學未來發展

- 核酸檢測相關產品將可大幅取代傳統檢驗方式
- 多種類的蛋白質晶片，在個人化藥物方面，標的藥物基因研究方面，如何將藥物治療作為研究目標的新知識，用基因試驗來確認，對藥物具不良反應者或無療效的人，製藥廠可經由的基因風險暴露來防範藥害，在基因診斷、試驗和治療方面，對傳染病和癌症的治療也漸轉變為基因診斷、這些進展都有助於醫院病人安全維護以及臨床醫療效能的提昇。
- 基因診斷、試驗和治療方面，對傳染病和癌症的治療也漸轉變為基因診斷、這些進展都有助於醫院病人安全維護以及臨床醫療效能的提昇。
- 分子生物檢驗技術、免疫生物感測技術、奈米生醫技術、預防醫學檢驗、生醫微機電技術等未來均會有長足的進展。
- 保健與老年檢測、小型家用檢驗自動儀器增加，非侵入性檢測以及食品衛生、環境毒素之檢測量均會提昇。





檢驗醫學未來發展

- Increased **automation and standardization** have far outpaced the laboratory professional involvement in assuring optimal test utilization and interpretation.
- The productivity of **‘commodity’ testing** (商品化檢驗) increases, the value of laboratory services seems to decrease contextually.
- It remains the **translation of laboratory data into valuable information** for improving patient's outcomes.
- An effective strategy to encompass translation into integrated, multidisciplinary care, in which appropriateness in **test request and interpretation**.





未來醫檢師必要的技能

- Laboratory professionals have to become the patient's best source of information about **laboratory results**, concerning patient preparation guidelines, preanalytical issues, and interpretative counseling (檢驗諮詢).
- They have to expand the consultative assistance for physicians as regards appropriateness and interpretation, also **developing practice guidelines for the appropriate use of laboratory services** and in closer cooperation with the stakeholders.
- They have to assure the **quality of laboratory testing**, irrespective of where they are performed (e.g., POCT), expanding the governance throughout the total testing process, to embrace all steps from test request to result utilization.





未來醫檢師必要的技能

- We have to better communicate the quality of laboratory data by introducing **information on the assay performance** (e.g., the total error) in laboratory reports, thus making the **analytical uncertainty a more understandable concept for clinicians**, and the reference change value for serial results.
- Laboratory professionals with a **medical background** must maintain a close interaction with the clinical context, assuming **a direct responsibility in patient management**, participating in multidisciplinary teams and initiatives for defining diagnostic pathways and improving the global quality of healthcare.
- Clinical laboratories should enhance **efficiency** and **reduce costs** by forming alliances and networks; **consolidating**, integrating, or outsourcing; and more importantly.





Reflex and reflective testing

Table 1 Reflex and diagnostic thresholds applied prospectively

Scenario	Reflex rules	Exclusion criteria	Diagnostic threshold
Hypovitaminosis D	Calcium ≤ 2.10 mmol/L And Alkaline phosphatase > 150 IU/L Age > 55 y	25-hydroxy-vitamin D measured within previous 90 days	25-hydroxy-vitamin D < 50 nmol/L
Hypomagnesaemia	K ⁺ < 2.5 mmol/L Or Albumin-adjusted calcium < 1.80 mmol/L	None	Magnesium < 0.70 mmol/L
Hypothyroidism	TSH > 4.0 mU/L	None	Free thyroxine < 11.0 pmol/L
Hyperthyroidism	TSH < 0.10 mU/L	None	Free thyroxine > 22.0 pmol/L
Hereditary haemochromatosis	50 $<$ ALT < 200 U/L (women) 60 $<$ ALT < 200 U/L (men) Age 18–40 y	Hospital inpatients, outpatients Iron studies measured within previous 90 days	Transferrin saturation (%): $> 50\%$ (women) $> 55\%$ (men)

TSH, thyroid-stimulating hormone; ALT, alanine aminotransferase





醫檢師

- 過去：檢驗流程的操作者
- 現在：檢驗儀器的管理者
- 未來：檢驗醫學的設計者與應用者





醫檢教育

- 學校: 提供檢驗醫學的基礎
- 實習: 提供檢驗技術的基本訓練 (選修)
- 見習: 提供檢驗流程與臨床溝通的基本訓練
- 初階醫檢師: 特定專業檢驗的操作
- 中階醫檢師: 檢驗數據的判讀
- 高階醫檢師: 檢驗流程的設計及檢驗諮詢





醫檢師培育

- 專業技術之訓練
- 品管知識之培育
- 資訊發展之應用
- 醫學資料之熟悉
- 專才-----全才
- 專業性
- 競爭力



Thank your attention !





醫檢師未來發展

- 高階醫檢師
- 檢驗醫學的研究
- 檢驗儀器的發展
- 檢驗資訊的規劃
- 參考實驗室的提供

