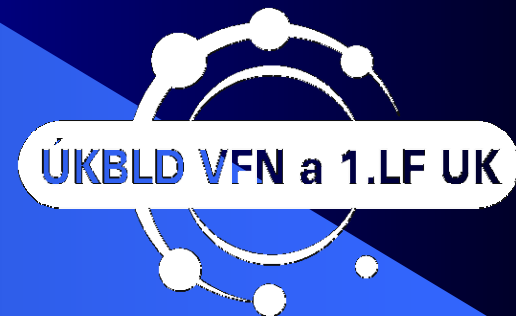


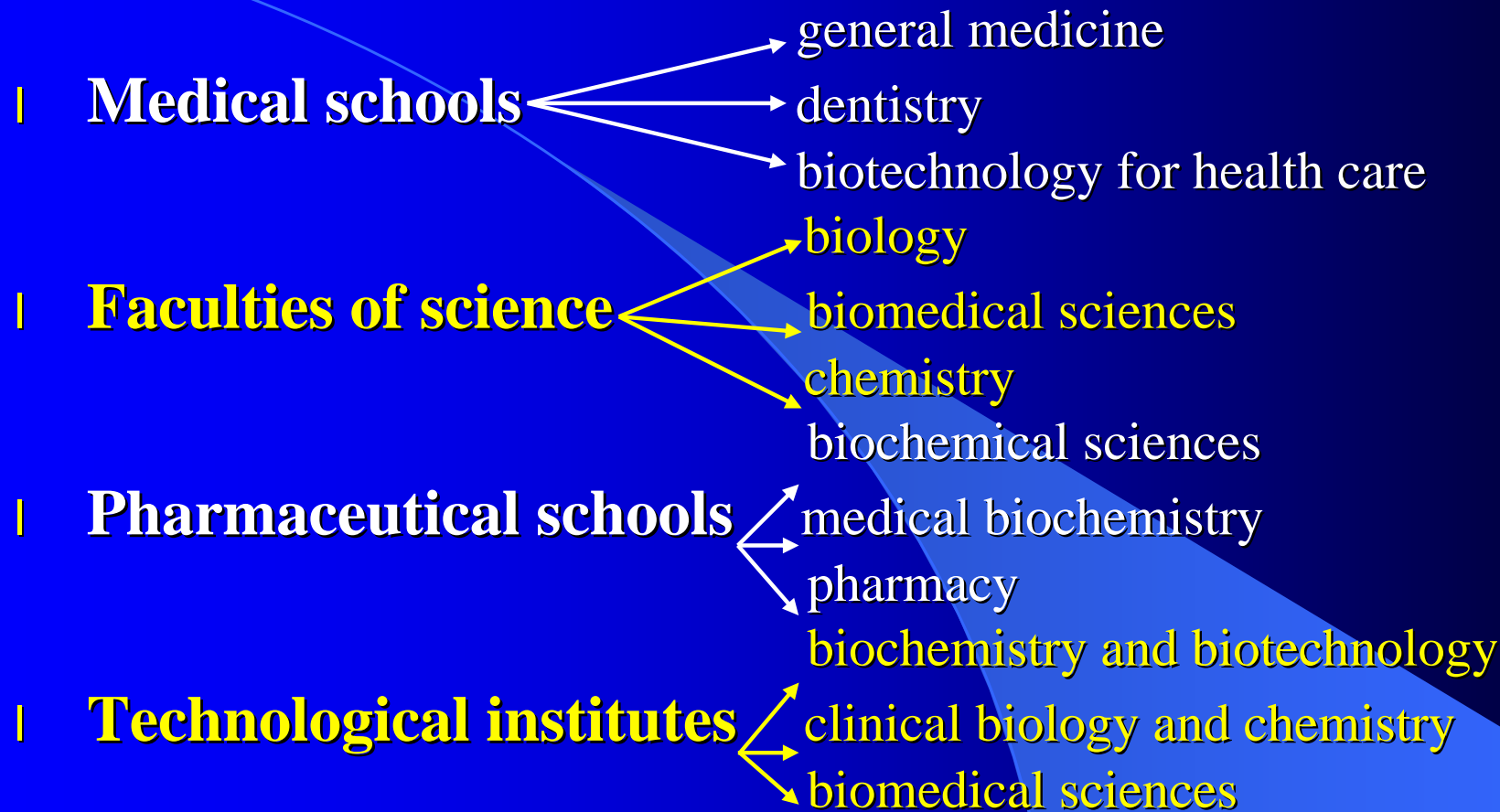
# Pregraduate and postgraduate education regarding clinical biochemistry

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# Pregradual courses



# Length of study at medical schools

- | 5 y in some Irish medical schools (Cork, Dublin)
- | **6 y usually**
  - according to the EU regulations, the studies should include **5500 h or 6 y**
- | 7 y in Belgium
- | discussions in Ireland regarding the possibility of studying medicine as a second school
  - e. g., after legal studies
  - medical studies would, in that case, last 4 years

# Length of study at other schools

- | Biomedical sciences 4 – 5 y usually in all types of schools
- | Pharmacy 5 – 7 y
- | Biology, chemistry, biochemistry and biotechnology 5 y usually

# The Bologna Declaration

- | to create a European space for higher education
- | the adoption of a common framework of readable and comparable degrees
- | the introduction of undergraduate and postgraduate levels in all countries
  - with first degrees no shorter than 3 years
- | ECTS-compatible credit systems
- | a European dimension in quality assurance
- | the elimination of obstacles to the free mobility of students and teachers

# Organization of medical education

**Studies are organized in 2 ways:**

## | **Gradually, problem based learning**

- Is utilized in Austria
- in other countries it is either prevalent or utilized by only some schools

## | **Combined systems with subject-oriented modules**

- in the pre-clinical part
- or
- in the clinical part

## | **Classic subject arrangement**

Teachers have problems with this organization, because many modules in several terms, but always just a few hours

The Bologna process of education standardization is discussed<sub>6</sub>

# Organization of medical education

## Bachelor's and master's studies

- | **Only in Belgium** are medical studies divided into
  - bachelor's studies (3 y - preclinical)
  - and master's studies (4 y - clinical)
- | **Division into the pre-clinical and the clinical part of study is used in numerous countries**
  - some schools require a state examination upon completion of the pre-clinical part
  - although the programme of study is not called a bachelor's or master's programme

# Organization of medical education

## Pre-graduate English language studies outside Ireland and the United Kingdom

- | **Schools of large EU countries do not offer pre-graduate education in English** and do not intend to make any changes in the future
  - except for Spain
- | **Pre-graduate education in English is not available in some other countries either**
  - e.g. in Belgium, Denmark, Finland, the Netherlands, and Sweden
  - special courses or individual lectures presented by hosting professors may be in English



# Medical schools

## Courses in chemistry

- | **Chemistry classes were traditionally a prerequisite to biochemistry**
  - many medical schools have terminated chemistry classes
  - the other have kept as a part of the module-oriented studies
  - or in the classic subject arrangement.
    - | the chemistry may be taught from the faculty of chemistry
- | **The chemistry is taught in the 1st, 2nd or 3rd term**
  - lectures are usually complemented with practical training

# Medical school Courses in biochemistry

- | **Biochemistry** is taught
  - as an individual subject
  - or as a part of several modules
    - | e.g., physiology, biology, or molecular biology
  - some medical schools do not offer biochemistry
- | **Classes usually start during the 2nd term and end in the 4th term**
  - lectures are usually complemented with seminars
  - the proportion of teaching is decreasing and self-directed learning is increasing
  - some medical schools offer a plethora of specialized seminars
    - | the number of students may decrease to two participants

# Medical school Courses in biochemistry

- | **Practical training in biochemistry** is offered at approximately half of the schools
  - The organization of practical training is either:
    - | all students (divided into pairs) work on the same task
    - | or there are several tasks and students rotate between them (more demanding for the leading practitioner)
  - Some schools have very large rooms for practical courses (up to 90 students)
  - There is usually a large difference in equipment between research laboratories and teaching laboratories

# Medical school

## Courses in clinical biochemistry

- | **Clinical (bio)chemistry** is taught
  - as an independent subject in Scandinavia and some other countries
  - in France, Portugal, and in most of Ireland, it is a part of another subject
    - | e.g., biochemistry, internal medicine, or pathology
- | **Lectures may start in the 4th term but usually in the 5th term**
  - several-hour lectures can be a part of subject-oriented modules
  - lectures are complemented by seminars
    - | case reports are discussed in very small groups (6 students)
  - there is usually no practical training in clinical (bio)chemistry
    - | there are renowned schools (Oxford, Munich), which allot more than 30 h for practical training

## Total number of biochemistry and clinical biochemistry classes in medical study programs

Country visits/total number of Medical Schools	Biochemistry (hours)	Clinical biochemistry (hours)	Distribution of study
Austria – 3/3	26–134	0–37	32–37 modules
Belgium – 2/9	88–180	0–100	3 y Bachelor's degree + 4 y Master's degree
Denmark – 1/3	179	18	1. Basic subjects, 2. Organ courses, 3. Int. medicine + surgery 4. Clin. education
Ireland – 4/5	36–150	0–35	Modular study (3–4 y pre-clinical + 2 y clinical)
Finland – 2/5	120–162	26–142	2 y pre-clinical + 4 y clinical
France – 5/47	57–148	As a part of internal medicine	2 y pre-clinical + 4 (3) y clinical

# Total number of biochemistry and clinical biochemistry classes in medical study programs

Country visits/total number of Medical Schools	Biochemistry (hours)	Clinical biochemistry (hours)	Distribution of study
Germany – 17/37	0–234	0–132	2 (3) y pre-clinical+4 (3) y clinical
United Kingdom – 4/27	0–78	20–132	3 y pre-clinical+3 y clinical
Italy – 4/33	120–193	30–145	1.5–2.5 y pre-clinical + 3.5–4.5 y clinical
Netherlands – 2/8	In internal medicine or as a part of a module	2–6	4 y pre-clinical+2 y clinical
Portugal – 4/6	47–218	As a part of biochemistry and pathology	2 (2.5) y pre-clinical +1 (0) y mix+3 (3.5) y clinical
Spain – 2/31	110–144	0–43	3 y pre-clinical+3 y clinical
Sweden – 3/6	0–24	24–96	3 (3.5) y pre-clinical +3 (2) y clinical
Czech Republic – 7/7	110–252	20–63	2 y basic subjects+2 y principles of clin. medicine+ 2 y clin. education (1x) not divided (6x)

# Curriculum for clinical biochemistry at the 1st Faculty of Medicine in Prague

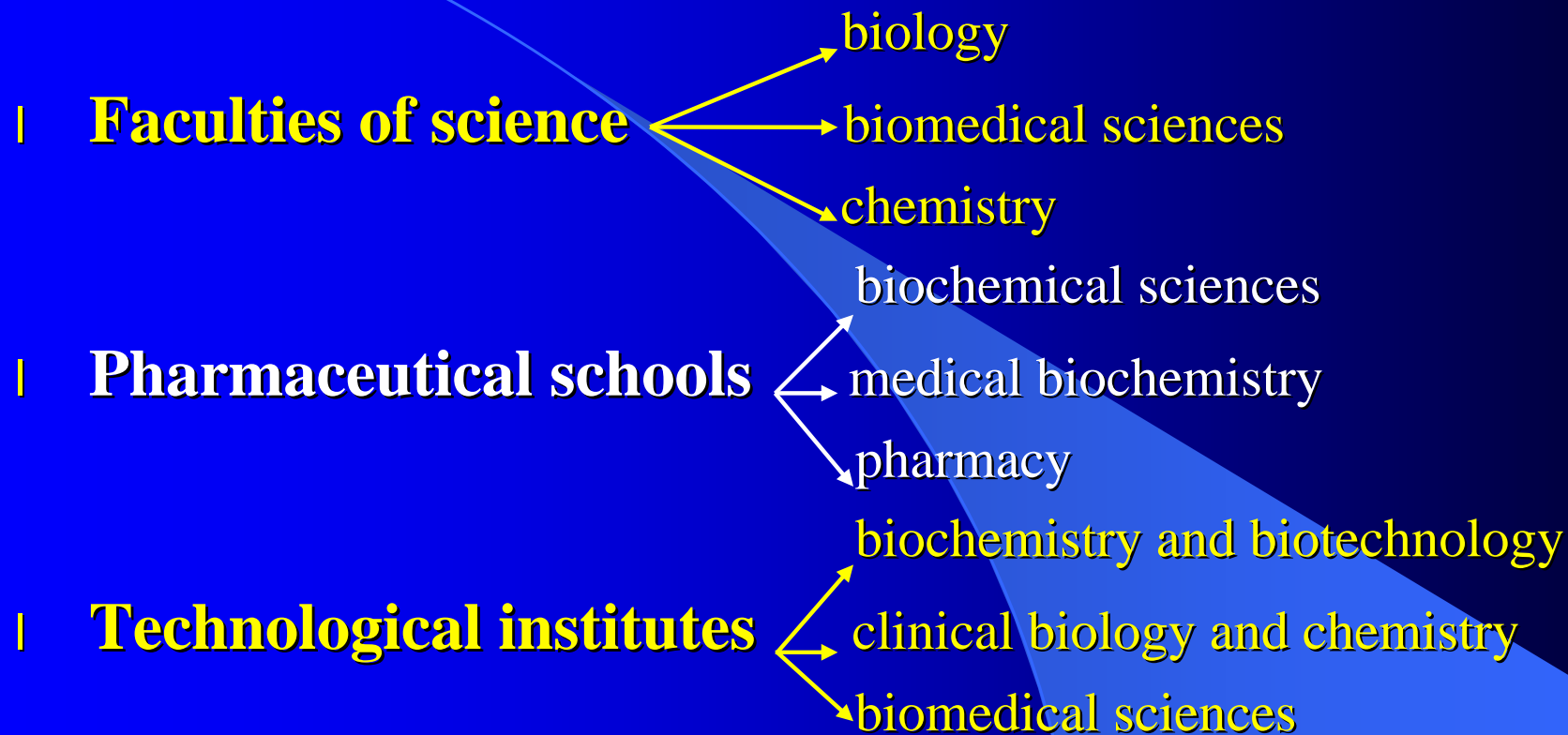
- | Preanalytical phase, POCT and interpreting results
- | Electrolyte balance disorders and acid base balance
- | Indications and Interpretation of test
  - Gastroenterology
  - Hepatology
  - Nephrology
- | Cardiac markers
- | Functional and screening tests
- | Tumor markers
- | Markers of inflammation
- | Therapeutic drug monitoring
- | Molecular biology methods and cytogenetics
- | Laboratory diagnostics of inborn errors of metabolism

# Non-medical healthcare fields of study at medical schools

- | **Italian medical schools** offer a wide variety of three-year medical fields of study
  - In connection with **biotechnology for health care**, major attention is paid to laboratory practice and to final single-semester works
    - | the subject of biochemistry and human biochemistry represents 160 h,
    - | and laboratory practice with a final work represents 245 h
  - **Technicians for Biochemical Laboratories** take a total of
    - | 500 h of biochemistry, clinical biochemistry, molecular biology, and cellular biology
  - Clinical biology and POCT take 60 h in the **nursing bachelor's programme**
- | The majority of **Czech medical schools** provide 3-y bachelor's studies
  - two of them also provide follow-up two-year master's programmes



# Pregradual courses in **non-medical schools**



# Organization of education in **non-medical schools**

## | e.g. **France**

- 85% of the directors or deputy directors of private laboratories have pharmacy degrees
- 15% are medical biologists

## | **Pharmacy studies** are divided into 3 cycles:

- 1-2 y: biology, physics, mathematics, chemistry, physiology, and public health
- 3-4 y: principal diseases, analytical chemistry, drugs, pharmacology, TDM, toxicology, bacteriology, virology, haematology, immunology, serology
- 5-6y: the organization of the health system, hospital training

## | **Study of medical biology** has been structured as 2 levels:

- 1-2 y: haematology, biochemistry, bacteriology, parasitology or immunology
- 3-5 y: hospital pharmacy, pharmacotoxicology, pharmacokinetics, public health and environment, pharmaco-epidemiology, gene and cell therapy, hospital hygiene, biotechnology and nanosciences, diagnosis in vitro, nutrition, and new therapies (12months part-time practical training)

# Organization of education in **non-medical schools**

- | e.g. **Bradford**
- | **Biomedical sciences**
  - **1-3/4 y bachelor's studies:** Cell Biology, biological molecules and biochemistry, human genetics, microbiology, medical physiology, reproductive biology and embryology, clinical and analytical biochemistry, human physiology and pharmacology, immunology, pathology, biotechnology and the human genome, gene expression and cellular communication
  - Educational program exceeding 4 y, may be divided into bachelor's and master's sections (Germany, Sweden)

# Organization of education in **non-medical schools**

| e.g. **Zagreb**

| **Faculty of Pharmacy and Biochemistry**

– 1-4 y: basic chemistry, analytical chemistry, biochemistry, clinical biochemistry, immunochemistry, hematology, transfusional medicine, pharmaceutical chemistry, toxicology, molecular diagnostics, cytology and histology, neurochemistry

# Organization of education in **non-medical schools**

| e. g. **Prague**

| **Institute of Chemical Technology**

- **Bachelor study of biochemistry and biotechnology 1-3 y:**  
biology, toxicology, foods, biochemistry, analytical chemistry,  
microbiology, molecular genetics
- **Master study of general and applied biochemistry 4-5 y:**  
molecular biology, genetic engineering, enzymology,  
pathobiochemistry, human pathology, biochemistry of microbes,  
hematology and immunology, biological active natural products,  
determination of analytes in medicine

# Postgraduate study

```
graph TD; A[Postgraduate study] --> B[Specialization clinical education]; A --> C[PhD degree scientific education];
```

**Specialization**  
*clinical education*

**PhD degree**  
*scientific education*

# Current state of post-graduate, but specialization training in Laboratory Medicine - EC4

EC4 has established standards to recognise a high level of education and professional training in the EU which include:

- a) university degree in medicine, biochemistry, chemistry, biology, pharmacy;
- b) 9 years university and postgraduate study;
- c) 4 years specialist training after 1st degree;
- d) multidiscipline or single discipline;
- e) registered in country of origin (if applicable).

# Standards for the **PhD degree** in biomedicine

## A proposal from:

- | Organisation for PhD Education in Biomedicine and Health Sciences in the European System (**ORPHEUS**)
- | The Association of Medical Schools in Europe (**AMSE**)
- | The World Federation for Medical Education (**WFME**)



# Standards for the **PhD degree** in biomedicine

## | **Two types of standards:**

### – **Basic standard**

- | describes standards that must be met from the outset

### – **Quality development**

- | describes standards that are in accordance with international consensus about good practice

# Standards for the **PhD degree** in biomedicine

- | Applicants for a PhD programme must have an **educational level** corresponding to a master's degree, or to a medical degree

A PhD programme must not be initiated unless the resources for completion of the PhD research project are available

- | In choosing PhD students, **the potential** of the applicant **for research** should be considered, and **not just past academic performance**

# Standards for the **PhD degree** in biomedicine

- | PhD programmes must be **performed under supervision**
- | PhD programmes must be structured with a clear time limit, a **length equivalent to 3-4 years full time**
- | The programme must include **formalised courses** totalling **about 6 months** (~30 ECTS points) parallel with the PhD project
- | There must be arrangements to allow PhD students, if relevant, **to perform part of their PhD programme at another institution**

# Standards for the **PhD degree** in biomedicine

- | The principal supervisor, at least, should have some **formal training as a supervisor**
- | An **abstract** of the PhD thesis **should be published in English**
- | PhD theses should be published on the graduate school's home page
  - preferably *in extenso*
- | The assessment committee has at least **two scientists from another institution**
  - at least one should be from another country
- | **The supervisor must not be a member of the assessment committee**

# PhD degree in biomedicine

## | **The majority of students trainees in clinical biochemistry are not graduates of medical schools**

- mostly graduates of scientific, pharmaceutical, and biotechnological schools
- **strong support for postgraduate education may bring very positive results**
  - | at the medical school in Würzburg up to 5% of graduates continue in scientific work in their Ph.D. programme

# PhD degree in biomedicine

- | **In some countries, this type of study is not particularly popular** due to the limited number of options upon completion of demanding studies
  - scholarship is low,
  - and sometimes students are legally prohibited from having any other commitments
- | Staff members at biochemical and clinical chemistry institutions explain the limited interest in doctoral studies by the fact that these **highly qualified experts are relatively poorly paid and face difficulties in the job-market**

**There are two key factors determining the  
respective competence of laboratory  
staff:**

- professional training**
- appropriate human resources management**

## B. R. Smith 2008

Change from a 5 y minimum for training in both A.P. and C.P. to a 4 minimum in U. S. had had **an adverse effect on attaining competency in clinical chemistry**



# **Mario Plebani 2008**

**Medical education may seem to be in a perpetual state of unrest, but the education of laboratory professionals is an even more challenging and controversial issue**

# Professor Mitchell Scott

1. Should we train anyone in laboratory medicine?
2. If so, should we train more or fewer people?
3. How should they be trained?

There is a need to train more laboratory physicians and scientists, not fewer

# Graham H. Beastall

- | **Medical laboratory assistants in UK** do not require formal qualifications and do not currently require registration to practice, although local assessment of competence is standard.
- | The largest staff group, technologists called **biomedical scientists**, acquire a Bachelor of Science degree, require to be registered to practice with the Health Professions Council and must undertake continuing professional development.

- | Approximately 1000 individuals function at the level **Membership of the Royal College of Pathologists in UK** clinical biochemistry, of which
  - some 25% are medical graduates
  - and 75% science graduates
- | The curriculum is designed to take 5 y to complete
- | **Medical and clinical scientists sit the identical examination**

# Continuing professional development in the UK

- | Participants are required to complete and record a total of at least 250 h of structured CPD over a 5-y period
- | One feature of clinical biochemistry education and training in clinical biochemistry that is especially well developed in the UK is recognition that both scientific and medical graduates can function at consultant level

# Conclusion

- | **Education provided by individual EU medical schools is not properly harmonized**
- | Schools are independent institutions that are extremely proud of their past and traditions
  - cooperation in the innovation of study programmes of the individual schools is not often sought after or achieved
- | **The future depends on our trainees and thus on our training programs**

# Consensus document

## Basic level in CC & LM

### Pregradual education

### Whats we need

- | *Introducing laboratory tests*
- | *Core biochemistry*
- | *Specialized investigations and other laboratory fields*
  - Tests in endocrinology, Tumor markers, TDM, Molecular biology etc.

# **Consensus document** **PhD degree in biomedicine**

**Document approved by the ORPHEUS  
Executive Committee**

**Prague, 12 October 2011**



# **Consensus document**

## **Combined PhD - clinical specialisation programmes**

**The aim of a combined programme is to train medical doctors to become professional clinical specialists with a PhD**

### **Training needs to consider the following components:**

- the student to have time sharing between the clinic and research
- research work to be in an area related to the clinical specialization
- the theoretical training to include issues relevant for clinical research
- this involves making an annual progress report
- the student should interact with other PhD students

***Thank you for your  
attention***

