

# Comparison of Dutch and Czech Systems of Pharmacy Studies

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This article describes the comparison of two systems of pharmacy studies, one in the Netherlands (NL) and one in the Czech Republic (CZ). The schemes of the study of pharmacy, the Dutch curriculum and Czech curriculum for students of pharmacy, credit systems and practices were compared. Special attention was devoted to the comparison of all the subjects involved in the Dutch and Czech curricula. In the Netherlands, it is possible to study pharmacy in two programmes: Bachelor's Degree or Master's Degree. In the Czech Republic it is only possible to study pharmacy as a Master's Degree. The length of study for Dutch students in the Master's Degree programme takes six years, while Czech students need only five years for the same programme. Dutch students are educated through a block system and Czech students through a 14 day schedule with a regular exchange of subjects. The credit system (European credits) is the main tool for the evaluation of students in Europe. The credit system used in the Netherlands is as follows: one European credit = 28 h of work. The credit system is not yet established in the Czech Republic, where students are still evaluated by a system of grades. Pharmacy practice as a topic runs in both curricula, but in different ways. However, six months of pharmacy practice in the last year of study (according to the requirements of the European Union directives) will start in the academic year 2004 / 2005 in the Czech Republic.

*Keywords:* Bachelor's Degree; Credit system; Curriculum; Master's Degree; Pharmacy practice; System of pharmacy study

## INTRODUCTION

The European Union is aiming for a unification of all curricula for pharmacists, resulting in similar university education of pharmacists each country. The European Union specifies the requirements,

which each country must fulfil, to ensure that its curriculum will be suitable.

What is the current situation in the Czech Republic (CZ)? There are many changes in the Czech curriculum for pharmacists at the Faculty of Pharmacy (FPHK) of Charles University in Hradec Kralove. The Faculty of Pharmacy has prepared a new curriculum according to the requirements of the European Union. It starts in the academic year 2004/2005, containing changes in subjects and introducing a six month period of a continual pharmacy practice in the fifth year at the end of the programme.

The University Centre for Pharmacy (UCP) of the University of Groningen in the Netherlands (NL) has also prepared a new curriculum, which started in the academic year 2000/2001.

The aim of this study is to compare these two new curricula for pharmacists. All informations mentioned in this article concerns only the UCP of the University of Groningen (whenever the title "Dutch" is used) and the FPHK of Charles University in Hradec Kralove (whenever the title "Czech" is used).

This article concentrates on:

- (1) Programmes of pharmacy study in the Netherlands (NL) and in the Czech Republic (CZ) (schemes of studies in both countries);
- (2) Dutch curriculum and Czech curriculum-description of courses in NL and CZ (compulsory and compulsory-selective subjects);
- (3) Credit systems, especially in NL;
- (4) Practices (stage) in both countries, predominantly in NL.

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## METHOD

The results in this article were acquired through studying student guides and other materials designated for Dutch and Czech students of pharmacy (Guide for Dutch students of Pharmacy and Pharmaceutical sciences, 2001/2002; 2003/2004; Schedule of lectures and exams for Dutch students, 2003/2004; Schedule of lectures and exams for Czech students, 2004/2005), by interviewing personnel who are responsible for teaching, practices, education, etc., by observation of teaching (some lectures and seminars) and finally by searching via the internet.

## RESULTS

### Study Programmes

The organisation of the study of pharmacy is different at the UCP and at the FPHK. In the Czech Republic, there is one programme of study leading only to a Master's Degree (Fig. 1). This programme is general and prepares graduates for all branches of pharmacy (pharmacy, research, pharmaceutical industry, etc.). Students can choose only from the compulsory-selective subjects (the prescribed number of subjects from a list of offered subjects) according to their orientation for a future career (see Appendix A). In the Netherlands students can choose either a Bachelor's Degree or a Master's Degree. They can study for a Bachelor's Degree of pharmacy or pharmaceutical sciences (general pharmaceutical sciences or technical pharmacy). Master's Degrees are offered in pharmacy, medical-pharmaceutical sciences or pharmaceutical product engineering (Fig. 2).

Programmes start with propedeutics (basic preparative subjects, necessary for specialized, pharmaceutical subjects) in both degrees. Those students who want to work as pharmacists in

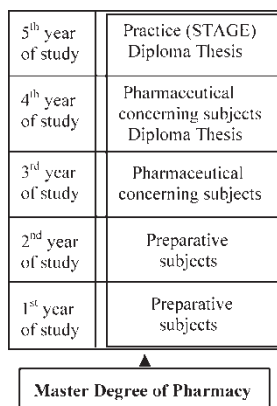


FIGURE 1 Layout of the one-branch study of pharmacy at the Faculty of Pharmacy in Hradec Kralove.

pharmacies have to choose the Master's Degree programme of Pharmacy, which is the only programme that has a length of six years. After graduation, the students have to continue in their professional education (a "pre-registration period"). The university is not responsible for this two year pre-registration period; it is organised by the Royal Dutch Association of Pharmacy (KNMP).

The Czech curriculum is less flexible compared with the Dutch curriculum, which enables a greater variety of choices (see Appendix B). Another difference is in the length of study. While Dutch students study six years for their Master's Degree of Pharmacy, Czech students only need five years for an equivalent qualification.

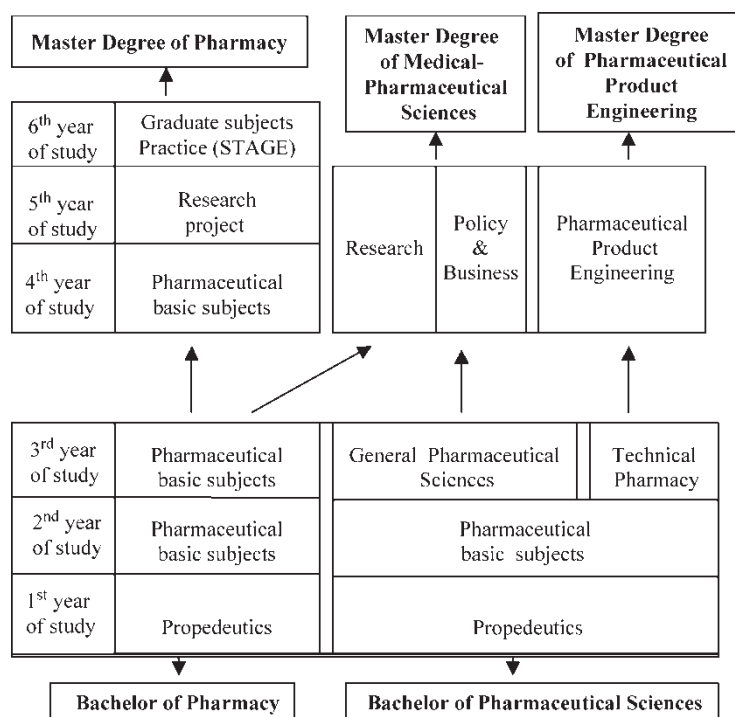
Differences are also seen in the number of students and teachers at both institutions. While at the UCP there are about 600 students educated by 42 teachers (a ratio of 14:1), 95 teachers educate about 1000 students at the FPHK. The ratio is 14:1 for the UCP and 10.5:1 for the FPHK. The Dutch students are educated through a block system (sometimes called modules). This means that the students spend a period studying one subject (e.g. Analytical Chemistry). At the end of each block they sit an exam in the studied subject before commencing a new block with another subject. Conversely, Czech students are educated in a 14 day schedule with different subjects alternating every day and every lesson within winter and summer semesters. Each semester consists of 14 weeks of contact hours (lectures, practices and seminars vs. self-study) and it is closed by an examination period (six weeks), when students study and take their exams in the designated subjects.

A further difference is seen in the teaching methodology. While lectures (passive education) are still a dominant form of theoretical teaching for Czech students in most subjects, seminars with a small number of students are preferred at the UCP where discussion between the teacher and students are common.

Are there any similarities between the countries? Yes, especially in the effort of teachers to educate and prepare new specialists (students-graduates) for careers in all fields of pharmacy.

### Curricula Courses

It is interesting to compare the two curricula in the structure of subjects. Table I provides an overview of all compulsory subjects from the curricula of both institutions for a comparison of subject composition (see Guide for Dutch students of pharmacy and pharmaceutical sciences, 2003/2004; Schedule of lectures and exams for Czech students 2004/2005). All the compulsory subjects were divided into four groups: Chemical subjects (CH), Biological-Medical

**Legend:**

**Propedeutics** = basic preparative subjects, necessary for specialized (pharmaceutical) subjects

FIGURE 2 Layout of the study of Pharmacy and Pharmaceutical sciences at the University Centre for Pharmacy in Groningen (Guide for Dutch students of Pharmacy and Pharmaceutical sciences 2003/2004).

TABLE I Overview of all the compulsory subjects from the both new curricula

Type of subjects	Concrete compulsory subjects	*	#	
Chemical (CH) NL: Theory 31.5 EC Practice 22.5 EC Subtotal: 54.0 EC	General and Analytical Chemistry	II	1	
	Physical Pharmacy (Physical Chemistry)	I	1; 6	
	Organic Chemistry (+Biorganic)	I	1	
	Analytical Chemistry	I	1	
	Pharmacochemistry	II	2	
CZ: Theory 17.25 EC Practice 15.75 EC Subtotal: 33.00 EC	Pharmaceutical Chemistry	I	1; 4	
	Bioanalysis	II	1	
	Pharmaceutical Inorganic Chemistry	II	2	
	General and Inorganic Chemistry	III	1	
	Biological-Medical (B-M) NL: Theory 45 EC Practice 10 EC Subtotal: 55 EC	Biology of Cell	II	1
Physiology I + II		II	1	
Pharmaceutical Microbiology		I	1	
Central Nervous System		II	2	
Pharmaceutical Biology		II	2	
CZ: Theory 16.25 EC Practice 13.25 EC Subtotal: 29.50 EC		Genetics	II	2
		Digestive System and Respiratory System	II	2
		Immunology	I	1; 6
		Pathophysiology	II	2
		Circulatory System	II	2
		Endocrine System	II	2
		Infections and Tumours	II	2
		Biophysics	III	1
		General Biology	III	1
		First Aid	III	1
Human Morphology and Physiology	III	1		
General Biochemistry	III	1		
Pathology	III	1		
Molecular Biology	III	2		

TABLE I – *continued*

Type of subjects	Concrete compulsory subjects	*	#
Pharmaceutical-Social(P-S)	Pharmacy and Society (Social Pharmacy)	I	1
NL: Theory 41 EC	Diabetes	II	2
Practice 74 EC	Technical Pharmacy	II	1
Subtotal: 115 EC	Introducing into Pharmacy	II	1
	PC-use	I	3
CZ: Theory 35.25 EC	Mathematics and Statistics	I	1; 6
Practice 68.25 EC	General Pharmacology I + II	II	2
Subtotal: 103.50 EC	Pharmacokinetics	II	1
	Orientation in Research of Drugs	II	2
	Metabolism and Toxicology	I	1; 6
	Technology and Biopharmacy (Pharmaceutical Technology)	I	1
	Biostatistics	II	1
	Pharmacoepidemiology	II	1
	Pharmacology	I	1; 4
	Ethics	II	2
	Communication and Orientation	II	3
	Research Project (Diploma Thesis)	I	1; 4
	Latin language	III	3
	History and Organisation of Pharmacy Ethics in Health Service	III	2
	Pharmaceutical Botany	III	1
	Laboratory Techniques	III	3
	Basics of Legislative	III	2
	Pharmacognosy	III	1
	Health Psychology	III	1
	Extrapharmacy Practice	III	3
	Economics and Management of Pharmaceutical Practice	III	2
	Pharmacoinformatics	III	3
	Excursion into Pharmaceutical Industry	III	3
	Veterinary Drugs	III	2
	Chemical Drug Control	III	1
	Physical Training and Sport	III	3
Concerning work in pharmacy (Apotheek) (A)	Introducing into Pharmacy (Propedeutical Pharmacy Practice)	I	1; 5
NL: Theory 24 EC	Prescriptions and Preparation of Drugs	II	1
Practice 72 EC	General Pharmacotherapy	II	3
Subtotal: 96 EC	Introduction into Practical Pharmacotherapy	II	1
	Management in Pharmacy	II	2
	Pharmacy Practice/Management in Pharmacy	II	3
CZ: Theory 3.75 EC	Medical devices I	I	1;4;7
Practice 59.25 EC	Prescription—Theory and Practice	II	1
Subtotal: 63.00 EC	Ethics and Legislative in Pharmacy	II	1
	Research and Production of Drugs	II	1
	Profession	II	2
Sum: NL: Theory 141.5 EC	Communication	II	1
Practice 178.5 EC	GIMMICS	II	1
Subtotal: 320.0 EC	Pharmacy Practice	I	1;5
Comp-select subj: 40.0 EC	Clinical Pharmacy	III	1
Total: 360.0 EC	Pharmacy Practice-subject	III	1
	Social Interaction and Communication	III	1
Sum: CZ: Theory 72.5 EC			
Practice 156.5 EC			
Total: 229.0 EC			

\*I = subject is in both countries (NL, CZ), II = subject is only in NL, III = only in CZ; #: 1 = both (theory-T + practice-P), 2 = only T, 3 = only P, 4 = T is only in CZ, 5 = T is only in NL, 6 = P is only in CZ, 7 = P is only in NL; EC = European credits, comp-select subj. = compulsory-selective subjects; GIMMICS = Groningen Institute Model for Management In Care Services.

subjects (B-M), Pharmaceutical-Social subjects (P-S) and subjects concerning work in a pharmacy (Apotheek) (A). Table I shows whether the subject is taught only in NL, only in CZ or in both countries; whether it involves only theory (T), only practice (P) or both; Table I also includes information about the number of European credits (EC) in theory and practice in NL and in CZ in each group from these four group of subjects. The summary of the number of EC is shown in Table II.

It is of note that Dutch students are not acquainted with the basics of veterinary drugs, Latin language and, to a lesser extent, with medicinal plants. On the other hand, the Czech students have little exposure to clinical pharmacy. It is possible to read from Table I that in NL there is a wider spectrum of subjects. The biggest portion (in a number of subjects and in a number of EC) from these four group of subjects is represented by Pharmaceutical-Social subjects in both countries; the biggest difference in the number of

TABLE II Summary of the number of EC from Table I

Type of subjects	The Netherlands		The Czech Republic	
	Theory	Practice	Theory	Practice
Chemical	31.5	22.5	17.25	15.75
Biological-Medical	45.0	10.0	16.25	13.25
Pharmaceutical-Social	41.0	74.0	35.25	68.25
Concerning work in pharmacy (Apotheek)	24.0	72.0	3.75	59.25
Total	141.5	178.5	72.50	156.50

EC, comparing theory, is in NL concerning Biological-Medical subjects, while on behalf of practice (same situation in NL and in CZ), is in the group of subjects concerning work in a pharmacy (Apotheek).

### Credit System

Dutch students are assessed by the credit system of EC. This was started in the academic year 2003/2004 at the UCP. Before that, students were evaluated by a different credit system (one credit = 40 h of work = one week), which had existed since 1979.

In the new system one EC = 28 h of work. This includes lectures (25%) and self-study (75%). The practices and seminars involve fewer hours of self-study. Students have to obtain a certain number of the EC (Table III). Each exam is evaluated by a specific number of the EC (see Appendix C) and students can repeat the exams several times. A certain link between the subjects has to be followed (it is only possible to take some subject if the previous subject, connected with next subject, is passed).

The credit system (European credits) is not yet established at the FPHK and Czech students are currently evaluated by a system of grades. Nevertheless Appendix D, which was created artificially by

TABLE III Number of European credits (EC) which Dutch students have to obtain during the programme-Master's Degree of Pharmacy at the University Centre for Pharmacy in Groningen (Guide for Dutch students of Pharmacy and Pharmaceutical sciences 2003/2004)

Propedeutics	Propedeutical subjects	60
Bachelor of Pharmacy	Compulsory undergraduate basic subjects	56
	Undergraduate basic subjects	64
	Subtotal	180
Master of Pharmacy	Undergraduate basic subjects	19
	Graduate basic subjects	44
	General Educational Subject	5
	Research Project	40
	3 Selective Subjects	15
	Pharmacy Practice (Stage)	37
	Specialisation of Pharmacist in. ....	20
	Subtotal	180
Total	360 EC	

Propedeutics = basic preparative subjects, necessary for specialized (pharmaceutical) subjects.

a calculation, shows the theoretical number of ECs for each subject in the Czech programme.

### Practices

A practice stage runs in both countries. Dutch students have to attend a pharmacy practice environment for 26 weeks. The first time they get to know a pharmacy from the inside is during a one day excursion into a pharmacy during the first year of study. The main part of their practice experience is during the later years of study and it is divided into different periods.

The first period, which lasts four weeks, starts in the fourth year of study and is called "management practice". Students are acquainted with the basics of management of work in a pharmacy. For this practice only some pharmacies are selected.

Other periods run in the sixth year of study and they are divided into four periods. The first period, usually six weeks, typically starts in a community pharmacy. After that, the second period, which is about eight weeks, often follows in a hospital pharmacy. The third period, about seven weeks, follows again in a community pharmacy. The periods are finished by the fourth period, lasting one week, when students write two reports about their practices.

Dutch students can choose places in pharmacies from a list of pharmacies containing addresses of pharmacies and the practices have to be taken in at least three different pharmacies, two periods in a community pharmacy and one period in a hospital pharmacy.

Dutch students are provided with a booklet "Stage-handleiding voor de apothekersopleiding" (Practice-handbook for pharmacy education) that describes all the aspects of a course of practice in detail. The booklet contains the list of all activities specific for a community and a hospital pharmacy. Students have to cover most of the points in this booklet during their practices. The list of points can be used by the student as well as by the pharmacist, to ensure the practice to be a period of academic education and as an educational support. In community pharmacy these sections are mentioned:

- Drug and raw material management;
- Preparation of medical preparations;
- Delivering drugs to the patient;
- Drugs guarding;
- Patient counselling;
- Management in a pharmacy;
- Tasks of the pharmacist;
- Hygiene and environment.

In a hospital pharmacy these sections are mentioned:

- Management and organisation;
- Drugs and raw materials;
- Preparation of medical preparations;

- Drug distribution and pharmacotherapy;
- Clinical pharmaceutical laboratory.

Dutch students write two reports after finishing the practices. The first report describes the course of the practice, their actual work there (pharmacy vision, layout and normal working schedule, personal tasks, special projects done by the students) and their personal opinions (and optionally their suggestions for improvement). In the second report, they demonstrate their own investigation in two subjects connected with the profession. This report comprises two articles (between 1600 and 3600 words) related to topics such as: purchase and procurement of drugs, technical apparatus and skills of pharmacy staff, preparation in a pharmacy, general management, patient information, OTC assortment, external distribution system, the pharmacy staff, collaboration with general practitioners and pharmacists, structure of healthcare, financial administration and policies regarding patient counselling. These articles may be offered for publishing in the weekly paper of the Royal Dutch Association of Pharmacy (KNMP). If everything is evaluated as suitable, students can go on to a final oral examination.

The FPHK will start with a new curriculum in the academic year 2004/2005 which also includes a new system of practices. In particular, it is now necessary to prepare the list of "accredited pharmacies" (pharmacies working according to the appropriate standards), where students will undergo their practice periods. This will be difficult at the hospital pharmacies because there are relatively few in the Czech Republic. As mentioned previously, a special booklet has been prepared describing a course of the practices for each Dutch student. This booklet can serve as an inspiration for the FPHK, because it has currently completed and refined the specifications of a new system of practices according to the directives of the European Union. A new scheme of practice has been prepared as part of the new Czech curriculum (Schedule of lectures and exams for Czech students 2004/2005) (Table IV). It is possible to compare this with the scheme of practices according to the old Czech curriculum (Table V).

TABLE IV The scheme of practices according to the new Czech curriculum

Year of study	Name of Practice	Length
First year	Propedeutical Pharmacy Practice	One week
Second year	Extrapharmacy Practice (not in pharmacies)	Two weeks
Third year	Excursion into Pharmaceutical Industry	One day
Fifth year	Pharmacy Practice	Six months

TABLE V The scheme of practices according to the old Czech curriculum

Year of study	Name of practice	Length
First year	Propedeutical Pharmacy Practice	One week
Second year	Extrapharmacy Practice (not in pharmacies)	Two weeks
Third year	Pharmacy Practice	Four weeks
Fourth year	Pharmaceutical Practice (anywhere)	Four weeks
Fifth year	Pharmacy and Pharmaceutical Practice	6 + 6 weeks

## DISCUSSION

### Study Programmes

The Dutch and Czech systems of pharmacy study are diverse in many aspects, nevertheless, there is a common effort to educate a new type of pharmaceutical expert. One of the most distinct differences is an option to study pharmacy as a Bachelor's Degree or as a Master's Degree at the UCP. It is a subject for discussion: "What is the position of the Bachelor of Pharmacy in the 'job market'?" Teachers from the UCP have not yet experienced this, because the first Bachelors of Pharmacy graduated in last academic year 2002/2003. Another difference is in the length of study. While Dutch students study six years for their Master's Degree of Pharmacy, Czech students study only five years for the equivalent programme. This type of organisation can also be found in Spain. Martinez (2000) says: "Spanish students of pharmacy read for five year period too, which is divided into two cycles. The first cycle is made up of three years and the second of two years" (Martinez, 2000). On the other hand, UK students need four years of study for a Master of Pharmacy Degree (Taylor and Harding, 2002), although they require a further one year of supervised training (the pre-registration year) before taking a registration examination.

### Curricula Courses

The Czech curriculum appears to be more restrictive than the Dutch curriculum, with the latter enabling a greater variety of choices and is more oriented towards pharmacotherapy. Why exactly did we choose the Dutch curriculum for comparison with the Czech curriculum? Pharmacy is aimed at pharmaceutical care at present and the Dutch curriculum is also orientated along those lines. Dutch students have more possibilities to include courses such as clinical pharmacy, pharmaceutical care and pharmacotherapy into their training. Should pharmacy education encompass a more generalised study, preparing for all branches of pharmacy, or a more specific study programme preparing for a certain branch? The FPHK has experience with both.

In the period between the years 1977–1991, the study of pharmacy was divided into three branches: general pharmacy, clinical pharmacy and technological pharmacy at the FPHK. This structure did not prove its worth, because it was not possible for graduates to change their branch of study. If a student chose, for example, technological pharmacy, he or she could not work in a pharmacy after graduation, and therefore FPHK has decided for one general programme of pharmacy study.

### Credit System

The use of a credit system for the evaluation of Dutch students has been operating for a long time at the UCP (it is enacted by Dutch law), but from 2003/2004 a new credit system with EC was established. In this new system one EC represents 28 hours of work. As mentioned previously, the credit system (European credits) is not yet used at the FPHK. Czech students are presently evaluated by a system of grades. The number of ECs in the Czech Republic used in Table I and in Appendix D serves only as a model for comparison (it was created artificially by a calculation) of the Dutch and Czech systems of pharmacy study (compare Appendix C and Appendix D). Into this calculation were included all contact hours (one EC = 28 h of contact hours) and an added time of an examination period, when Czech students study to prepare for their exams. We can also find the experience with the credit system in Spain, "Spain's entry into the European Union meant a greater mobility for Spanish students. New terminology such as the idea of a 'credit' was introduced which had never been used before. There is the obligation to set aside 10% of the total credit load so that electives can be chosen at the discretion of each student." (Lopez-Lafuente and Castillo, 2000).

### Practices

Both new curricula (Dutch and Czech) suit the requirements of the European Union for the periods of pharmacy practice. The European Union directs in these requirements a compulsory six month period of continual pharmacy practice in the last year of study for students of pharmacy (Directive 85/432/EEC). Another issue for discussion is whether students of pharmacy should have contact with a pharmacy from the inside (real work in the pharmacy) before the fifth or sixth year of study. According to the old Czech curriculum students passed through different kinds of practice in each year of study, starting from the first year (Table V).

The most extensive practice in the previous Czech curriculum was in the fifth year of study, but students first became acquainted with work in the pharmacy in the first year of study. In the second year of study they passed through the practice in a place other than in the pharmacy ("extrapharmacy practice") and they could view which fields pharmacy includes. The people who have responsibility for the practices at the FPHK, like the system (scheme) of practices according to the old Czech curriculum and therefore they have inserted part from this old scheme into the new Czech curriculum: the practice in the first and second year of study and an excursion into pharmaceutical industry in the third year of study (Table IV).

### CONCLUSION

It is interesting to study a curriculum for pharmacists of another country in that country. After that, it is easier to understand the organisation of study and to obtain more objective results from the comparison of two different systems of pharmacy study. The Dutch system of pharmacy study is sophisticated. It is a good opportunity for the Czech Republic, to be informed about the "strong points" of Dutch system.

As mentioned previously, the FPHK will start with a new curriculum in the next academic year 2004/2005, including a new system of practice, and therefore the Dutch system of pharmacy study can be helpful for the FPHK. In the meantime, the representatives of the FPHK are awaiting experience with the new curriculum and the new system of the practices.

### References

- Guide for Dutch students of Pharmacy and Pharmaceutical Sciences of the Faculty of Mathematics and Natural Sciences of the University of Groningen (2001/2002).
- Guide for Dutch students of Pharmacy and Pharmaceutical Sciences of the Faculty of Mathematics and Natural Sciences of the University of Groningen (2003/2004).
- Lopez-Lafuente, A. and Castillo, B. (2000) "Introduction: Pharmaceutical education in Spain", *Pharmacy Education* 1, 53–54.
- Martinez, J.L. (2000) "The Faculty of Pharmacy of the Complutense University of Madrid", *Pharmacy Education* 1, 59–61.
- Schedule of lectures and exams for Dutch students of Pharmacy and Pharmaceutical sciences of the Faculty of Mathematics and Natural Sciences of the University of Groningen (2003/2004).
- Schedule of lectures and exams for Czech students of the Faculty of Pharmacy of Charles University in Hradec Kralove according to the new Czech curriculum (2004/2005).
- Taylor, K.M.G. and Harding, G. (2002) "Teaching, learning and research in McSchools of Pharmacy", *Pharmacy Education* 2, 43–49.

**APPENDIX A: COMPULSORY-SELECTIVE SUBJECTS (CZECH STUDENTS WILL CHOOSE A FIXED NUMBER FROM THESE OFFERED SUBJECTS IN THE 3RD AND 4TH YEAR OF STUDY) AT THE FACULTY OF PHARMACY OF CHARLES UNIVERSITY IN HRADEC KRALOVE:**

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- Organic Chemistry and Biological Activity
- Chemometrics
- Special Methods of Instrumental Analysis
- Therapeutic Drug Monitoring
- Biotechnology
- Radiopharmacy
- Pathological Biochemistry
- Clinical Biochemistry
- Monitoring of Environment
- Phytotherapy
- Immunopharmacology
- Homeopathic Preparations
- Pathological-Medicinal Preparation
- Cosmetology for Pharmacists
- Technology of Synthetic Drugs
- Food Supplements
- Technology of Natural Drugs
- Gene Therapy
- Xenobiochemistry
- Medicinal Plants Production

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**APPENDIX B: COMPULSORY-SELECTIVE SUBJECTS AT THE UNIVERSITY CENTRE FOR PHARMACY OF THE UNIVERSITY OF GRONINGEN:**

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Dutch students choose *General Educational Subject* for 5 EC in the 5th year of study and 3 *Selective subjects* altogether for 15 EC in the 5th year of study too (wide choice, e.g. Analysis of Raw Material, Side Effects of Drugs and Post-marketing Study, Pharmacoeconomics, Pharmacy and Informatics, Introduction into Hospital Pharmacy, Work with Radioactivity...)

Then Dutch students choose from 2 blocks in the 6th year of study (Each block is for 20 EC):

1. Block: *Specialisation of Pharmacist in Pharmaceutical Care*-contains these subjects:
    - Organisation in Pharmacy (Apotheek) + Management in Pharmacy (Apotheek)—2 EC
    - Communication—3 EC
    - Pharmaceutical Biology and Phytotherapy—3 EC
    - Medical Devices II—3 EC
    - Organisation of Health Care and Pharmacy—3 EC
    - Specialist Pharmacotherapy—6 EC
  
  2. Block: *Specialisation of Pharmacist in Production and Quality*-contains these subjects:
    - Special Prescriptions—6 EC
    - Development and Control of Production—14 EC
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**APPENDIX C: LIST OF COMPULSORY SUBJECTS WITH A CONCRETE NUMBER OF EC (EUROPEAN CREDITS) AT EACH SUBJECT DURING THE STUDY OF MASTER'S DEGREE OF PHARMACY AT THE UNIVERSITY CENTRE FOR PHARMACY IN GRONINGEN IN THE NETHERLANDS (NL)**

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List of compulsory subjects with a concrete number of EC		1 y	2 y	3 y	4 y	5 y	6 y
CH	General and Analytical Chemistry	T 4, P 6					
	Physical Pharmacy ( <i>Physical Chemistry</i> )	T 4					
	Organic Chemistry (+ <i>Biorganic</i> )	T 9		P 6			
	Analytical Chemistry		T 6, P 4				
	Pharmacochemistry		T 4				
	Pharmaceutical Chemistry				P 4		
	Bioanalysis				T + P 4		
	Pharmaceutical Inorganic Chemistry <i>General and Inorganic Chemistry</i>					T 3	
B-M	Biology of Cell	T 7, P 3					
	Physiology I + II	T 4	T 3, P 3				



## APPENDIX C – continued

	List of compulsory subjects with a concrete number of EC	1 y	2 y	3 y	4 y	5 y	6 y
	Pharmaceutical Microbiology		T + P 4				
	Central Nervous System		T 4				
	Pharmaceutical Biology			T 3			
	Genetics			T 3			
	Digestive System and Respiratory System			T 3			
	Immunology			T 3			
	Pathophysiology			T 4			
	Circulatory System				T 4		
	Endocrine System				T 3		
	Infections and Tumours				T 4		
	<i>Biophysics</i>						
	<i>General Biology</i>						
	<i>First Aid</i>						
	<i>Human Morphology and Physiology</i>						
	<i>General Biochemistry</i>						
	<i>Pathology</i>						
	<i>Molecular biology</i>						
P-S	Pharmacy and Society ( <i>Social Pharmacy</i> )	T + P 3					
	Diabetes	T 3					
	Technical Pharmacy	T + P 6					
	Introducing into Pharmacy	T + P 3					
	PC-use	P 1					
	Mathematics and Statistics	T 6					
	General Pharmacology I + II		T 7				
	Pharmacokinetics		T 4	P 3			
	Orientation in Research of Drugs		T 2				
	Metabolism and Toxicology		T 4				
	Technology and Biopharmacy ( <i>Pharmaceutical Technology</i> )		T + P 9				
	Biostatistics			T + P 4			
	Pharmacoepidemiology			T + P 3			
	Pharmacology			P 6			
	Ethics			T 1			
	Communication and Orientation			P 10			
	Research Project ( <i>Diploma Thesis</i> )					P 40	
	<i>Latin Language</i>						
	<i>History and Organisation of Pharmacy Ethics in Health Service</i>						
	<i>Pharmaceutical Botany</i>						
	<i>Laboratory Techniques</i>						
	<i>Basics of Legislative</i>						
	<i>Pharmacognosy</i>						
	<i>Health Psychology</i>						
	<i>Extrapharmacy Practice</i>						
	<i>Economics and Management of Pharmaceutical Practice</i>						
	<i>Pharmacoinformatics</i>						
	<i>Excursion into Pharmaceutical Industry</i>						
	<i>Veterinary Drugs</i>						
	<i>Chemical Drug Control</i>						
	<i>Physical Training and Sport</i>						
A	Introducing into Pharmacy ( <i>Propedeutical Pharmacy Practice</i> )	T + P 1					
	Prescriptions and Preparation of Drugs			T + P 9			
	General Pharmacotherapy				P 11		
	Introduction into Practical Pharmacotherapy				T + P 3		
	Management in Pharmacy				T 1		
	Pharmacy Practice—Management in Pharmacy				P 6		
	Medical Devices I				P 1		
	Prescription—Theory and Practice				T 4, P 6		
	Ethics and Legislative in Pharmacy				T + P 3		
	Research and Production of Drugs				T + P 9		
	Profession				T 2		
	Communication						T + P 3
	GIMMICS						T + P 6
	Pharmacy Practice						T + P31
	<i>Clinical Pharmacy</i>						
	<i>Pharmacy Practice-subject</i>						
	<i>Social Interaction and Communication</i>						

Legend: CH = Chemical subjects, B-M = Biological-Medical subjects, P-S = Pharmaceutical-Social subjects, A = Subjects concerning work in pharmacy (Apothek), EC = European credits, 1–6 y = 1st–6th year of study, T = theory (numbers are in EC), P = practice (numbers are in EC). GIMMICS = Groningen Institute Model for Management In Care Services. Subjects written by italic letters are only in the Czech Republic. All APPENDIX C corresponds with Table I.

**APPENDIX D: LIST OF COMPULSORY SUBJECTS WITH A CONCRETE NUMBER OF EC (EUROPEAN CREDITS) AT EACH SUBJECT DURING THE STUDY OF MASTER'S DEGREE OF PHARMACY AT THE FACULTY OF PHARMACY OF CHARLES UNIVERSITY IN HRADEC KRALOVE IN THE CZECH REPUBLIC (CZ)**

List of compulsory subjects with a concrete number of EC		1 y	2 y	3 y	4 y	5 y
CH	<i>General and Analytical Chemistry</i>					
	<i>Physical Pharmacy (Physical Chemistry)</i>	T 1.5, P 2.25				
	<i>Organic Chemistry (+Bioorganic)</i>	T 1.5, P 0.75	T 2.25, P 3			
	<i>Analytical Chemistry</i>		T 5.25, P 4.5			
	<i>Pharmacochemistry</i>					
	<i>Pharmaceutical Chemistry</i>			T 4.5, P 4.5		
	<i>Bioanalysis</i>					
	<i>Pharmaceutical Inorganic Chemistry</i>					
	<i>General and Inorganic Chemistry</i>	T 2.25, P 0.75				
B-M	<i>Biology of Cell</i>					
	<i>Physiology I + II</i>					
	<i>Pharmaceutical Microbiology</i>	T 1.5, P 1.5				
	<i>Central Nervous System</i>					
	<i>Pharmaceutical Biology</i>					
	<i>Genetics</i>					
	<i>Digestive System and Respiratory System</i>					
	<i>Immunology</i>		T 1.5, P 1.5			
	<i>Pathophysiology</i>					
	<i>Circulatory System</i>					
	<i>Endocrine System</i>					
	<i>Infections and Tumours</i>					
	<i>Biophysics</i>	T 2.25, P 1.5				
	<i>General Biology</i>	T 1.5, P 1.5				
	<i>First Aid</i>	T 0.5, P 0.5				
		<i>Human Morphology and Physiology</i>		T 3, P 2.25		
	<i>General Biochemistry</i>		T 3, P 2.25			
	<i>Pathology</i>		T 1.5, P 2.25			
	<i>Molecular Biology</i>		T 1.5			
P-S	<i>Pharmacy and Society (Social Pharmacy)</i>					T 1.5, P 1.5
	<i>Diabetes</i>					
	<i>Technical Pharmacy</i>					
	<i>Introducing into Pharmacy</i>					
	<i>PC-use</i>	P 0.75				
	<i>Mathematics and Statistics</i>	T 0.75, P 0.75				
	<i>General Pharmacology I + II</i>					
	<i>Pharmacokinetics</i>					
	<i>Orientation in Research of Drugs</i>					
	<i>Metabolism and Toxicology</i>			T 0.75, P 0.75		
	<i>Technology and Biopharmacy (Pharmaceutical Technology)</i>					T 6.75, P 7.5
	<i>Biostatistics</i>					
	<i>Pharmacoepidemiology</i>					
	<i>Pharmacology</i>			T 4.5, P 2.25	T 1.5, P 2.25	
	<i>Ethics</i>					
	<i>Communication and Orientation</i>					
	<i>Research Project (Diploma Thesis)</i>			T 1.5, P 0.75	P 9	P 11.25
	<i>Latin Language</i>	P 2.25				
	<i>History and Organisation of Pharmacy</i>					
	<i>Ethics in Health Service</i>	T 3.75				
	<i>Pharmaceutical Botany</i>	T 3, P 1.5				
	<i>Laboratory Techniques</i>	P 3				
	<i>Basics of Legislative</i>	T 1.5				
<i>Pharmacognosy</i>		T 1.5, P 1.5	T 1.5, P 5.25			
<i>Health Psychology</i>		T 0.75, P 0.75				
<i>Extrapharmacy Practice</i>		P 4.5–10 d				
<i>Economics and Management of Pharmaceutical Practice</i>			T 1.5			
<i>Pharmacoinformatics</i>			P 0.75			
<i>Excursion into Pharmaceutical Industry</i>			1 day			
<i>Veterinary Drugs</i>				T 1.5		
<i>Chemical Drug Control</i>			T 1.5, P 3.75	T 1.5, P 2.25		
<i>Physical Training and Sport</i>	P 3	P 3				

APPENDIX D – *continued*

	List of compulsory subjects with a concrete number of EC	1 y	2 y	3 y	4 y	5 y
A	<i>Introducing into Pharmacy (Propedeutical Pharmacy Practice) Prescriptions and Preparation of Drugs General Pharmacotherapy Introduction into Practical Pharmacotherapy Management in Pharmacy Pharmacy Practice—Management in Pharmacy Medical Devices I Prescription—Theory and Practice Ethics and Legislative in Pharmacy Research and Production of Drugs Profession Communication GIMMICS Pharmacy Practice Clinical Pharmacy Pharmacy Practice-subject Social Interaction and Communication</i>	P 2.25–5 d		T 1.5	T 0.75, P 0.75 T 0.75, P 1.5	P 54–6 m
				T 0.75, P 0.75		

*Legend:* CH = Chemical subjects, B-M = Biological-Medical subjects, P-S = Pharmaceutical-Social subjects, A = Subjects concerning work in pharmacy (Apotheek), EC = European credits, 1–5 y = 1st–5th year of study, T = theory (numbers are in EC), P = practice (numbers are in EC), d = days, m = months  
GIMMICS = Groningen Institute Model for Management In Care Services *Subjects written by italic letters are only in the Netherlands.* All APPENDIX D corresponds with Table I.