

Does the subject content of the pharmacy degree course influence the community pharmacist's views on competences for practice?

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Abstract.

Do community pharmacists coming from different educational backgrounds rank the importance of competences for practice differently - or is the way in which they see their profession more influenced by practice than university education?

A survey was carried out on 68 competences for pharmacy practice in 7 countries with different pharmacy education systems in terms of the relative importance of the subject areas such as chemical and

medicinal sciences. Community pharmacists were asked to rank the competences in terms of relative importance for practice; competences were divided into personal and patient-care competences. The ranking was very similar in the 7 countries suggesting that evaluation of competences for practice is based more on professional experience than on prior university education.

Introduction.

In 1985, the then European Economic Community published a directiveⁱ on pharmacy practice that assumed that pharmacy education in the EEC was broadly comparable and thus that the European education system was producing pharmacists with similar competences. In the early 1990s, the European Association of Faculties of Pharmacyⁱⁱ questioned these assumptionsⁱⁱⁱ. EAFP surveyed pharmacy courses in the 11 EEC members and found that although the emphasis in most faculties was on chemical sciences, there was great variability in pharmacy degree courses in the EEC regarding the percentages of time spent on different subjects^{iv}.

At that time it was hoped that European integration would produce greater harmonisation in pharmacy education and therefore in competences for practice. In 2011, the PHARMINE (“*PHARMAcy Education IN Europe*”) project^v revisited this problem. In the 20-year interval in several countries there was a shift from chemical to medicinal sciences between the 2 studies. Albeit, overall variability in degree courses from country to country had not decreased^{vi}.

As a follow-up to PHARMINE, a second study, the PHAR-QA (“*Quality Assurance in European PHARmacy Education and Training*”) project^{vii}, again funded by the European Commission, asked community pharmacists to rank competences for pharmacy practice.

This paper combines the results of the PHARMINE and PHAR-QA studies. It looks at whether the nature of the degree course (in terms of the relative importance of the subject areas chemical and medicinal sciences taken as an indication of a more “scientific” or a more “clinical” course) has any influence on the way in which community pharmacists ranked the competences they consider are required for practice.

Methodology.

A subject area course index was calculated as: ((percentage of contact hours spent on medicinal subjects / percentage of contact hours spent on chemical subjects) x 100) using data from the PHARMINE study as given in the 2014 paper on heterogeneity of pharmacy education cited above^{vi}.

In the PHARMINE study, “medicinal subjects” included contact hours in the subjects of anatomy, physiology, medical terminology, pathology, histology, nutrition, pharmacology / pharmacotherapy, toxicology, haematology, immunology, parasitology, hygiene, emergency therapy, non-pharmacological treatment, clinical chemistry / bio-analysis, radiochemistry, dispensing process, drug prescription, prescription analysis (detection of adverse effects and drug interactions), generic drugs, planning, running and interpretation of the data, of clinical trials, medical devices, orthopaedics, OTC medicines, complementary therapy, at-home support and care, skin illness and treatment, homeopathy, phyto-therapy, drugs in veterinary medicine, pharmaceutical care, pharmaceutical therapy of illness and disease. “Chemical subjects” included contact hours in the subjects of general and inorganic chemistry, medical physico-chemistry, organic chemistry, pharmacopeia analysis, analytical chemistry, pharmaceutical chemistry including analysis of medicinal products.

Ranking data on competences for practice were taken from the PHAR-QA *surveymonkey*^{viii} questionnaire that was available online from 14/2/2014 through 1/11/2014 *i.e.* 8.5 months. Here we will present the data for community pharmacists; data for other professional categories will be presented elsewhere^{ix}.

The first 6 questions were on the profile of the respondent asking, amongst others, country of residence, current occupation, and duration of activity.

Questions 7 through 19 asked about 13 groups of competences with a total of 68 competences (see annex). Questions in groups 7 through 11 were concerned with personal competences and in groups 12 through 19 with patient care competences.

Respondents were asked to rank the proposals for competences with a Likert scale:

1. Not important = Can be ignored.
2. Quite important = Valuable but not obligatory.
3. Very important = Obligatory with exceptions depending upon field of pharmacy practice.
4. Essential = Obligatory.

Results are presented in the form of “scores” based on the methodology used in MEDINE2^x: score = (frequency rank 3 + frequency rank 4) as % of total frequency. Scores give more granularity and a better pictorial representation than the basic Likert data. Data were obtained from 39 European countries. Data presented here are from the 7 EU member states in which the number of respondents was >10 (table 1).

Statistical analysis.

Results are expressed as medians with 25 and 75% percentiles; differences amongst countries was analysed using the Kruskal-Wallis test followed by Dunn’s multiple comparisons test. All statistics were performed using GraphPad software^{xi}.

Results.

In table 1 are given medians for duration of practice. Kruskal-Wallis analysis showed a significant effect of country (P = 0.0014) and the Dunn’s multiple comparisons test showed that the duration of practice for the Czech Republic was lower than for Germany, Ireland or Spain. None of the other comparisons were significant.

Table 1 also shows the medicinal sciences / chemical sciences scores. In Germany the degree course is more “chemical”, in Belgium, the Czech Republic and Spain the importance of the two subject areas is equal, in The Netherlands and the United Kingdom there is a more “medicinal” course, and this is even more pronounced in Ireland. The medicinal / chemical ratio varies almost 4-fold from Germany (0.7) to Ireland (2.6).

Finally, table 1 shows the median rankings for competences. The Kruskal-Wallis test showed a significant difference amongst countries (P=0.0006) with a significantly higher median for Spain compared to Belgium, Germany and Ireland. None of the other multiple comparisons amongst countries reached statistical significance.

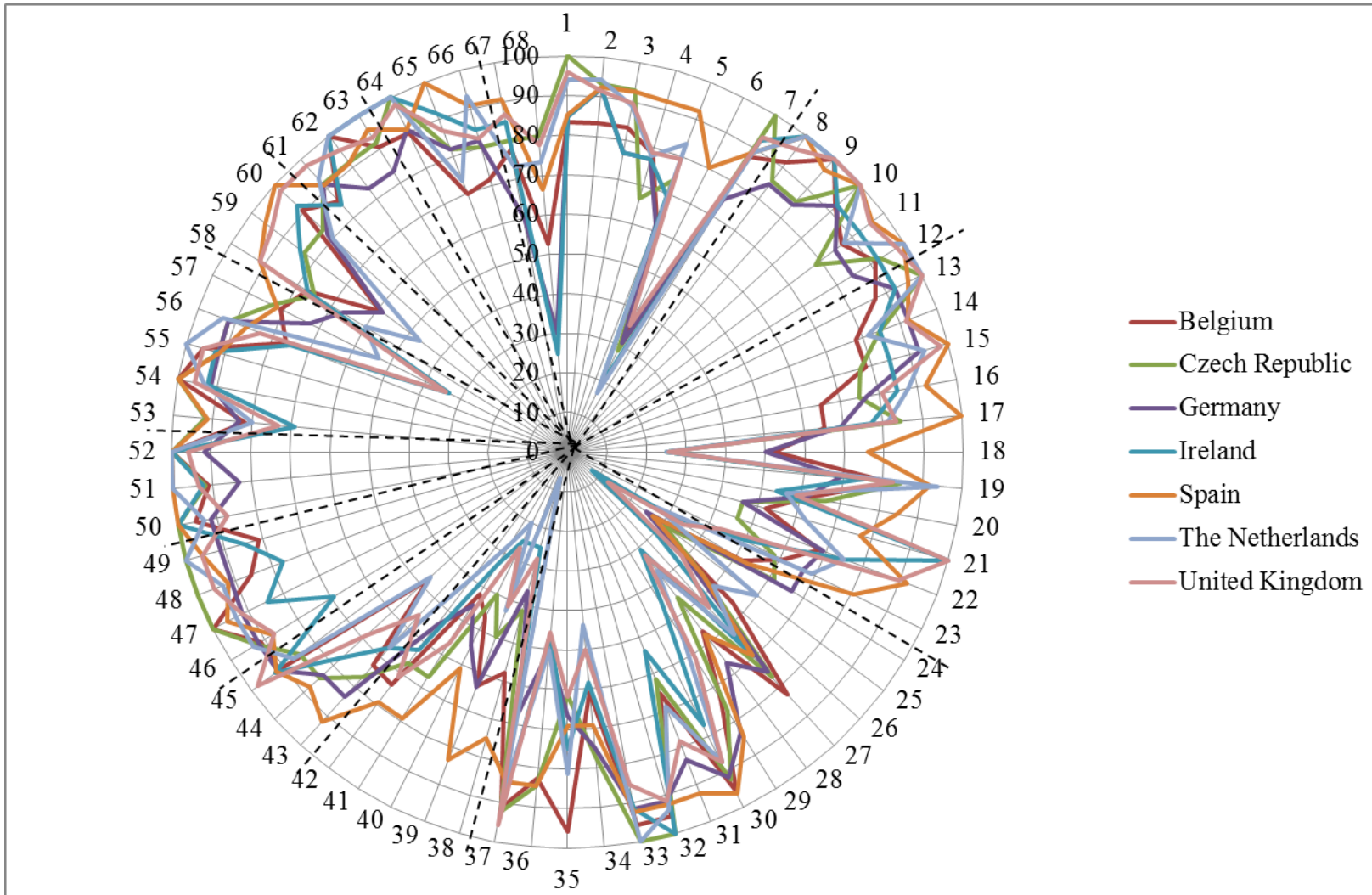
Table 1. Characteristics of the 7 countries, the medicinal sciences / chemical sciences indices (latter data from the PHARMINE study) and the rankings for competences.

Country	Number of respondents	Duration of activity (years; median, 25% and 75%)	Medicinal sciences %	Chemical sciences %	Medicinal / chemical score	Ranking of competences (median, 25% and 75%)

		percentiles)				percentiles, n = 68)
Belgium	25	10/5/20	24	27	1.1	81/63/91
Czech Republic	15	5/5/15	19	17	1.1	84/67/92
Germany	13	30/15/30	28	40	0.7	82/67/92
Ireland	13	20/10/33	36	14	2.6	77/55/92
Spain	27	15/10/30	28	24	1.2	91/82/96
The Netherlands	18	20/5/23	31	20	1.6	82/57/94
United Kingdom	48	10/5/20	24	14	1.7	87/59/96

In figure 1 are given the ranking scores for the 68 competences by the 7 countries.

Figure 1. Ranking scores (on the central vertical axe, 0-100%) for the 68 competences (on the circumference) by the 7 countries (in different colours). Dotted lines separate the 13 competence groups (see annex).



Spain often showed higher rankings, especially in groups 7 and 11. The difference between minimum and maximum for country ranking in group 7 (“personal competences: learning and knowledge”) competence 6 (“ability to design and conduct research using appropriate methodology”) was 63 (see annex); Spain ranked highest with 80% and Ireland and the Netherlands lowest with 18 and 17%, respectively. In group 11 (“personal competences: understanding of industrial pharmacy”) Spain ranked highest for all competences.

Discussion.

Opinions of the relative importance of competences appear to be formed by work experience rather than university education. In answer to the question “do community pharmacists coming from different educational backgrounds rank the importance of competences for practice differently” the answer is “no”. Examination of figure 1 shows that the ranking of competences for practice is very similar in 7 countries that have different systems of pharmacy education. It should be noted that the ranking score is based on a combination of ranks 3 and 4 that specify that competences are “obligatory”.

There are a few exceptions to this. Ranking of the competence “ability to design and conduct research using appropriate methodology” was high (80%) in Spain that has a medicinal / chemical score of 1.2 and low (18%) in Ireland with a medicinal / chemical score of 2.6. furthermore Spain scores highest for competences relating to industrial pharmacy (group 11) whereas, again, the medicinal / chemical score was average.

Several provisos should be added. It is possible that differences in ranking scores are related to duration of practice (*i.e.* numbers of years since leaving university) rather than to course content. This does not appear to be the case. The population of community pharmacists sampled in the Czech Republic was younger than in several other countries but the Czech Republic community pharmacists did not show any marked differences with other countries. Spanish community pharmacists did show a specific pattern of ranking in several groups of competences but their median duration of practice was mid-range.

The conclusion of this paper relies on the fact that the curricula investigated are as different as possible in the relative importance of 'medicinal' versus 'chemical' sciences component. The 7 countries selected were selected on the basis of having more than 10 respondents in the database. However Ireland has the highest value (1st / 26) and Germany the 3rd from the lowest (23rd / 26)^{vi}.

The PHARMINE study cited above showed that a competency approach is rarely used in pre-graduate pharmacy education in Europe. There have been several studies on the use of a competency framework to monitor and improve pharmacy practice in a working environment. A study using the general level framework with Singapore hospital pharmacists showed that in all but 8 of the 63 behavioural descriptors improved in 9 months^{xii}. A similar study with hospital pharmacists in Queensland showed an improvement in 35 out of 61 competences^{xiii}. Studies have also been conducted in Canada^{xiv} and elsewhere. The results of all these studies are that competence frameworks are useful tools to monitor and improve performance.

Conclusions.

In answer to the question “do community pharmacists coming from different educational backgrounds rank the importance of competences for practice differently?” the answer is “no”. This study clearly shows that community pharmacists form their opinions on the importance of competences of the basis of work experience rather than university education. The move to harmonise European pharmacy practice expressed in the 1980s seems to have been successful as judged from the similar way in which community pharmacists from different countries rank competences for practice. This is not the result of harmonisation of pharmacy education that shows wide diversity.

Perspectives.

The short-term perspective is the modification of the existing questionnaire according to the results obtained and the endorsement of the modified version.

The long-term perspective is the introduction of competency-based learning into the university curriculum for pharmacy. This is being discussed in Australia and New Zealand^{xv} and elsewhere. It now needs to be considered in Europe. Our results suggest that differences in university pharmacy programmes are not crucial in the development of specific competencies (at least in the field of community pharmacy, where the majority of pharmacists work). Thus we do not need a very stringent and tight framework for curricula of pharmacy education. Academia provides graduates with competencies as “novices” (according to five-stage model of competencies proposed by Dreyfus and Dreyfus, 1980^{xvi}). They then gather experience through practical training in the real job environment. Thus academic freedom should be incorporated into QA of pharmacy education especially when EU directive is “translated” into national frameworks.

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Annex. Ranking of competences by countries. (Seq. : sequential numbering (as in figure 1); Min.: minimum; Max.: maximum).

Note that the numbering of the groups of competences starts at 7, i.e. after the 6 questions on profile.)

Seq.	Competence	Belgium	Czech Republic	Germany	Ireland	Spain	The Netherlands	United Kingdom	Min.	Max.	Range: max. – min.
	<u>Group 7. Personal competences: learning and knowledge.</u>										
1	1. Ability to identify learning needs and to learn independently (including continuous professional development (CPD)).	83	100	85	85	85	94	96	83	100	17
2	2. Analysis: ability to apply logic to problem solving, evaluating pros and cons and following up on the solution found.	83	93	92	92	93	94	92	83	94	11
3	3. Synthesis: capacity to gather and critically appraise relevant knowledge and to summarise the key points.	83	93	77	77	93	89	90	77	93	16
4	4. Capacity to evaluate scientific data in line with current scientific and technological knowledge.	78	67	77	77	92	78	79	67	92	25
5	5. Ability to interpret preclinical and clinical evidence-based medical science and apply the knowledge to pharmaceutical practice.	63	73	62	69	92	83	79	62	92	31
6	6. Ability to design and conduct research using appropriate methodology.	33	29	31	18	80	17	36	17	80	63
7	7. Ability to maintain current knowledge of relevant legislation and codes of pharmacy practice.	88	100	75	92	89	89	93	75	100	25
	<u>Group 8. Personal competences: values.</u>										
8	1. Demonstrate a professional approach to tasks and human relations.	92	86	85	100	100	100	96	85	100	15
9	2. Demonstrate the ability to maintain confidentiality.	100	86	85	100	96	100	100	85	100	15
10	3. Take full personal responsibility for patient care and other aspects of one's practice.	92	100	92	92	100	100	100	92	100	8

11	4. Inspire the confidence of others in one's actions and advice.	87	79	85	92	96	88	96	79	96	18
12	5. Demonstrate high ethical standards.	92	93	85	92	100	100	98	85	100	15
	<u>Group 9. Personal competences: communication and organisational skills.</u>										
13	1. Effective communication skills (both orally and written).	87	100	92	92	96	100	100	87	100	13
14	2. Effective use of information technology.	78	85	92	85	92	81	92	78	92	14
15	3. Ability to work effectively as part of a team.	78	77	92	85	100	94	98	77	100	23
16	4. Ability to identify and implement legal and professional requirements relating to employment (e.g. for pharmacy technicians) and to safety in the workplace.	65	75	77	85	92	88	81	65	92	27
17	5. Ability to contribute to the learning and training of staff.	65	85	69	77	100	81	83	65	100	35
18	6. Ability to design and manage the development processes in the production of medicines.	52	25	50	25	76	25	26	25	76	51
19	7. Ability to identify and manage risk and quality of service issues.	82	85	69	75	92	94	83	69	94	25
20	8. Ability to identify the need for new services.	62	67	62	54	85	56	59	54	85	31
21	9. Ability to communicate in English and/or locally relevant languages.	52	46	46	100	77	63	100	46	100	54
22	10. Ability to evaluate issues related to quality of service.	68	46	69	75	92	75	90	46	92	46
23	11. Ability to negotiate, understand a business environment and develop entrepreneurship.	61	58	67	50	81	69	43	43	81	37
	<u>Group 10. Personal competences: knowledge of different areas of the science of medicines.</u>										
24	1. Plant and animal biology.	52	62	67	31	54	27	35	27	67	40
25	2. Physics.	26	31	25	8	27	60	13	8	60	52
26	3. General and inorganic chemistry.	57	46	42	31	46	50	39	31	57	26
27	4. Organic and medicinal/pharmaceutical chemistry.	83	77	75	69	69	63	53	53	83	29

28	5. Analytical chemistry.	57	46	67	31	58	38	33	31	67	36
29	6. General and applied biochemistry (medicinal and clinical).	74	77	83	46	85	56	62	46	85	38
30	7. Anatomy and physiology; medical terminology.	96	92	92	77	96	88	88	77	96	19
31	8. Microbiology.	65	62	83	54	92	69	78	54	92	38
32	9. Pharmacology including pharmacokinetics.	96	100	92	100	92	94	91	91	100	9
33	10. Pharmacotherapy and pharmaco-epidemiology.	96	100	92	92	92	100	85	85	100	15
34	11. Pharmaceutical technology including analyses of medicinal products.	61	77	75	58	69	44	50	44	77	33
35	12. Toxicology.	96	62	67	75	69	81	62	62	96	34
36	13. Pharmacognosy.	83	85	50	46	85	50	46	46	85	39
37	14. Legislation and professional ethics.	91	92	67	92	85	88	96	67	96	29
	<u>Group 11. Personal competences: understanding of industrial pharmacy.</u>										
38	1. Current knowledge of design, synthesis, isolation, characterisation and biological evaluation of active substances.	58	42	36	25	75	7	28	7	75	68
39	2. Current knowledge of good manufacturing practice (GMP) and of good laboratory practice (GLP).	63	50	64	25	83	43	42	25	83	58
40	3. Current knowledge of European directives on qualified persons (QPs).	47	40	55	25	61	20	27	20	61	41
41	4. Current knowledge of drug registration, licensing and marketing.	42	67	45	33	79	27	57	27	79	53
42	5. Current knowledge of good clinical practice (GCP).	74	67	55	63	79	40	71	40	79	39
	<u>Group 12. Patient care competences: patient consultation and assessment.</u>										
43	1. Ability to perform and interpret medical laboratory tests.	73	77	83	67	92	67	56	56	92	36
44	2. Ability to perform appropriate diagnostic or physiological tests to inform clinical decision making e.g. measurement of blood pressure.	48	85	83	77	88	47	69	47	88	41

45	3. Ability to recognise when referral to another member of the healthcare team is needed because a potential clinical problem is identified (pharmaceutical, medical, psychological or social).	91	85	92	92	92	87	98	85	98	13
	<u>Group 13. Patient care competences: need for drug treatment.</u>										
46	1. Retrieval and interpretation of relevant information on the patient's clinical background.	91	92	92	69	88	93	87	69	93	24
47	2. Retrieval and interpretation of an accurate and comprehensive drug history if and when required.	100	100	92	85	96	93	91	85	100	15
48	3. Identification of non-adherence and implementation of appropriate patient intervention.	86	100	91	77	92	93	96	77	100	23
49	4. Ability to advise to physicians and - in some cases – prescribe medication.	81	100	91	85	96	100	96	81	100	19
	<u>Group 14. Patient care competences: drug interactions.</u>										
50	1. Identification, understanding and prioritisation of drug-drug interactions at a molecular level (e.g. use of codeine with paracetamol).	95	100	92	100	100	93	87	87	100	13
51	2. Identification, understanding, and prioritisation of drug-patient interactions, including those that preclude or require the use of a specific drug (e.g. trastuzumab for treatment of breast cancer in women with HER2 overexpression).	91	92	83	92	100	100	93	83	100	17
52	3. Identification, understanding, and prioritisation of drug-disease interactions (e.g. NSAIDs in heart failure).	100	100	92	100	100	100	96	92	100	8
	<u>Group 15. Patient care competences: provision of drug product.</u>										
53	1. Familiarity with the bio-pharmaceutical, pharmacodynamic and pharmacokinetic activity of a substance in the body.	82	92	83	69	91	80	73	69	92	22
54	2. Supply of appropriate medicines taking into account dose, correct formulation, concentration, administration route and timing.	100	100	92	92	100	93	96	92	100	8

55	3. Critical evaluation of the prescription to ensure that it is clinically appropriate and legal.	95	92	92	92	91	100	96	91	100	9
56	4. Familiarity with the supply chain of medicines and the ability to ensure timely flow of drug products to the patient.	76	92	92	75	87	93	83	75	93	18
57	5. Ability to manufacture medicinal products that are not commercially available.	81	83	73	33	82	53	34	33	83	50
	<u>Group 16. Patient care competences: patient education.</u>										
58	1. Promotion of public health in collaboration with other actors in the healthcare system.	77	75	67	77	91	60	91	60	91	31
59	2. Provision of appropriate lifestyle advice on smoking, obesity, etc.	59	83	58	85	96	47	93	47	96	49
60	3. Provision of appropriate advice on resistance to antibiotics and similar public health issues.	90	83	82	92	100	80	98	80	100	20
	<u>Group 17. Patient care competences: provision of information and service.</u>										
61	1. Ability to use effective consultations to identify the patient's need for information.	86	92	92	85	91	93	98	85	98	13
62	2. Provision of accurate and appropriate information on prescription medicines.	100	92	83	100	91	100	95	83	100	17
63	3. Provision of informed support for patients in selection and use of non-prescription medicines for minor ailments (e.g. cough remedies...).	90	92	83	100	96	100	93	83	100	17
	<u>Group 18. Patient care competences: monitoring of drug therapy.</u>										
64	1. Identification and prioritisation of problems in the management of medicines in a timely manner and with sufficient efficacy to ensure patient safety.	90	100	91	100	91	100	98	90	100	10
65	2. Ability to monitor and report to all concerned in a timely manner, and in accordance with current regulatory guidelines on Good Pharmacovigilance Practices (GVPs), Adverse Drug Events and Reactions (ADEs and ADRs).	70	82	82	92	100	73	87	70	100	30

66	3. Undertaking of a critical evaluation of prescribed medicines to confirm that current clinical guidelines are appropriately applied.	71	80	82	85	91	93	82	71	93	22
	<u>Group 19. Patient care competences: evaluation of outcomes.</u>										
67	1. Assessment of outcomes on the monitoring of patient care and follow-up interventions.	78	80	60	85	90	73	87	60	90	30
68	2. Evaluation of cost effectiveness of treatment.	53	80	30	25	67	73	78	25	80	55

References.

- ⁱ The COUNCIL DIRECTIVE of 16 September 1985 concerning the coordination of provisions laid down by law, regulation or administrative action in respect of certain activities in the field of pharmacy. Available online: <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31985L0432&from=EN> (accessed on xx)
- ⁱⁱ European Association of Faculties of Pharmacy (EAFP) Available online: <http://www.eafponline.eu/> (accessed on xx)
- ⁱⁱⁱ ERASMUS Subject Evaluations: Summary Reports of the Evaluation Conferences by Subject Area, volume 1 pharmacy. Available online: http://ec.europa.eu/education/erasmus/doc/publ/conf_en.pdf (accessed on xx)
- ^{iv} Bourlioux, P. Proceedings of the 2nd European meetings of the faculties, schools and institutes of pharmacy, Berlin, September 1994. Available online: http://enzu.pharmine.org/media/filebook/files/Bourlioux_full_report.pdf (accessed on xx)
- ^v PHARMINE : pharmacy education in Europe. Available online : <http://www.pharmine.org/> (accessed on xx).
- ^{vi} Atkinson, J. Heterogeneity of pharmacy education in Europe. *Pharmacy* 2014, **2**(3), 231-243. Available online: <http://www.mdpi.com/2226-4787/2/3/231> (accessed on xx)
- ^{vii} The PHAR-QA project: Quality Assurance in European Pharmacy Education and Training. Available online: www.phar-qa.eu (accessed on xx)
- ^{viii} Survey Software - The Survey System. <http://www.surveysystem.com/sscalc.htm> (accessed on xx)
- ^{ix} Atkinson, J., *et al.*, The PHAR-QA project: Quality Assurance in European Pharmacy Education and Training. Results of the European network Delphi round 1, submitted for publication.
- ^x Marz, R., Dekker, F.W., Van Schravendijk, C., O'Flynn, S. and Ross, M.T. Tuning research competences for Bologna three cycles in medicine: report of a MEDINE2 European consensus survey. *Perp. Med. Educ.* 2013, **2**., http://download-v2.springer.com/static/pdf/799/art%253A10.1007%252Fs40037-013-0066-z.pdf?token2=exp=1429779128~acl=%2Fstatic%2Fpdf%2F799%2Fart%25253A10.1007%25252Fs40037-013-0066-z.pdf*~hmac=8cc61f57990544e852082e9749b6e580c1306f08bbab0d086.4cc9b01433864f8 (accessed on xx)
- ^{xi} GraphPad statistical pack. Available online: <http://www.graphpad.com/> (accessed on xx).
- ^{xii} Rutter, V., Wong, C., Coombes, I., Cardiff, L., Duggan, C., Yee, M-L., Lim, K.W., Bates, I. Use of a General Level Framework to Facilitate Performance Improvement in Hospital Pharmacists in Singapore. *Am. J. Pharm. Educ.* 2012, **76**: 1-10. <http://www.ajpe.org/action/doSearch?AllField=bates> (accessed on xx)
- ^{xiii} Coombes, I., Avent, M., Cardiff, L., Bettenay, K., Coombes, J., Whitfield, K., Stokes, J., Davies, G., Bates, I. Improvement in Pharmacist's Performance Facilitated by an Adapted Competency-Based General Level Framework. *J. Pharm. Pract. Res.* 2010, **40**: 111-118. <http://onlinelibrary.wiley.com/doi/10.1002/j.2055-2335.2010.tb00517.x/abstract> (accessed on xx)

^{xiv} Winslade, N.E., Tamblyn, R.M., Taylor, L.K., Schuwirth, L.W.T., Van der Vleuten, C.P.M. Integrating Performance Assessment, Maintenance of Competence, and Continuing Professional Development of Community Pharmacists. *Am. J. Pharm. Educ.* 2007; 71: 1-9.

<http://www.ncbi.nlm.nih.gov/pmc/journals/383/>

^{xv} Stupans, I., McAllister, S., Clifford, R., Hughes, J., Krasse, I., March, G., Owen, S., Woulf, J. Nationwide collaborative development of learning outcomes and exemplar standards for Australian pharmacy programmes. *Int. J. Pharmacy Practice.* 2014, 1-9. <http://onlinelibrary.wiley.com/advanced/search/results>

^{xvi} Dreyfus, S. E., Dreyfus, H. L. "A Five-Stage Model of the Mental Activities Involved in Directed Skill Acquisition", February 1980, Washington, DC, Storming Media.

<http://www.ieor.berkeley.edu/People/Faculty/dreyfus.htm>