CHOICE OF KEY BASIC CONCEPTS IN THE DESIGN OF A MEDICAL UNDERGRADUATE CORE CURRICULUM

A. Torsoli, Professor of Gastroenterology, Centre of Medical Education, P.P. Gazzaniga, Professor of General Pathology, Department of Experimental Medicine and Pathology, A. Marcheggiano, Senior Research in Gastroenterology, Department of Clinical Science Faculty of Medicine, and J. Osborn, Professor of Epidemiogical Methods, Institute of Hygiene 'G Sanarelli', University of La Sapienza, Rome

INTRODUCTION

The expansion of medical knowledge is rapid and greatly exceeds in volume the obsolete knowledge replaced.[1] The ever-increasing size of many disciplines, and consequently the number and extent of facts and theories to which students are exposed, has increased progressively and this is accompanied by difficulties of access to, and careful selection of, the more meaningful and fundamental information. The students' factual overload is made even greater by the tendency of some teachers to 'cover' their specific subject matter in as much detail as possible.[2] There is thus scope in identifying what appears to be really and absolutely essential for students to know for their future professional practice, and this has given rise to the concept of a 'core curriculum' to which a number of undergraduate medical education programmes already comply.

The initiative to collect a number of key concepts for basic medical sciences arose from our experience in the processes of teaching and learning in the 'Rome Parallel Track' experimental undergraduate medical course, started in 1995. The first intake of students to this course graduated in July 2000. This new course is founded on the principle of student-based training, conceived as the first part of a lifelong process of education. As a consequence, the learning process is active rather than passive, and an effort is made to introduce and solve the most common medical problems of professional medical practice. A positive attitude towards multi-professional co-operation is fostered and most of the teaching sessions are multi-disciplinary. This implies that it is not realistic to pursue exhaustive teaching in every teacher's speciality, and that the teachers should only introduce the core material necessary to impact an elementary basis of the subject being taught, thereby helping to resolve the problems which have a basis in this subject matter.

However, designing such a core curriculum may present many difficulties. In the clinical sciences, morbid conditions can be selected on the basis of their prevalence, severity, urgency, curability and intrinsic scientific interest.[3] What is more problematic is the selection of items from the basic sciences, even when the choice is limited to those which are necessary to understand the principal mechanisms underlying the selected clinical problems. In fact a danger is that a sufficient understanding of the information often requires previous knowledge, resulting in a sort of conceptual cascade which risks returning teaching to the traditional exhaustive approach. To some extent, the same difficulty applies to the principle of the precedence of *how* rather than *what* to teach and learn.

In addition, concern is sometimes felt that core curricula tend to reduce the teaching of theoretical aspects while favouring the acquisition of practical skills and professional performance.[4] However, it is widely accepted that a firm background of basic knowledge is needed for clinical decisions to be reached in the light of their scientific basis, and with full appreciation of scientific advances.

The identification of a set of key concepts from the basic sciences, which should be studied and retained by students until graduation and beyond, may be helpful. A large group of American faculties of medicine recently identified a list of essential basic concepts and also evaluated their intrinsic learning difficulties.[5]

The present investigation reports a study aimed at improving the co-ordination of basic and clinical science teaching in an experimental, problem-oriented medical course,[6] the 'Rome Parallel Track', where both basic and clinical sciences are simultaneously taught during the pre-clinical years. A list of concepts from the basic sciences considered important for scientifically valid professional practice was first submitted for scoring to a number of medical teachers, general practitioners and young graduates. Based on the mean scores and the level of concordance between various groups of respondents, a set of 'key' basic concepts was identified.

INVESTIGATION

In the first stage of the study, 12 teachers (nine basic scientists and three clinicians, Table 1) from different disciplines of the Faculty of Medicine, University *La Sapienza*, Rome contributed to a list of basic concepts that they considered important for medical practice. The resulting list comprised 202 items.

TABLE 1
Disciplines to which the 202 concepts referred.

- Epidemiology
- Biostatistics
- Medical physics
- Biochemistry
- Anatomy
- Genetics
- Biology
- Microbiology
- Physiology
- Pharmacology
- Immunology
- Basic pathology
- Medical methodology

A questionnaire listing the 202 items to be scored in relation to their importance (from 1 = poor to 5 = very high, 0 = don't know) was then distributed to 115 physicians and medical teachers. 76 of them (66%) filled it in and returned it. The respondents were divided into four groups (Table 2): group A, teachers of the 'Rome Parallel Track'; group B, teachers of conventional under-graduate courses; group C, general practitioners and group D, doctors graduated for less than two years. The mean values of the scores were calculated and a comparison was made between

TABLE 2
Groups of respondent physicians and medical teachers.

Group	Activity	Basic Sciences	Clinical Sciences	N
A	Teachers of the 'Rome Parallel Track'	9	11	20
B	Teachers of traditional courses	8	15	23
C	GPs			15
D	Recent graduates			18

groups and between basic and clinical scientists. Differences between the groups were investigated using McNemar's test for paired dichotomous data.

RESULTS

A mean score ≤ 4 within a group was arbitrarily considered to imply that the concept was judged by the group to be important. Table 3 shows the 17 basic concepts that were considered important by all four groups of respondents. By definition, for these 17 concepts there was absolute concordance between the four groups and these concepts might be considered as 'essential'.

Table 4 shows the 27 concepts that were judged to be important by three of the four groups. It is in selection of these concepts that the first signs of discordance between the groups become apparent. The recent graduates (group D) consider all of these 27 concepts important but in contrast the GPs (group C) rate only 6 as important. The teachers are more similar to the recent graduates; 23 and 25 of the 27 concepts are considered important by the 'Parallel Track' teachers (group A) and the other teachers (group B) respectively, and groups A, B and D do not differ significantly from each other. However, using McNemar's exact test for paired dichotomies, group C, the GPs, differs significantly from group A ($P<0.0001$), group B ($P<0.001$) and group D ($P<0.0001$). On average, the GPs believe that fewer of these concepts are important when compared with the teachers and recent graduates.

Table 5 shows the 31 concepts that were considered important by two of the four groups. Again the recent graduates (group D) consider all the concepts important and the teachers of the 'Parallel Track' think similarly about 26 of the concepts, and thus groups A and D do not differ significantly. In contrast, groups B (other teachers) and C (GPs) considered only 4 and 1 of these concepts important respectively, and this difference is not statistically significant. However, all of the comparisons between either A or D and either B or C are highly significant, $P<0.0001$.

Considering all 202 concepts, the differences between the four groups were statistically significant. No significant differences were observed between the clinicians and basic scientists in groups A and B.

DISCUSSION

The experimental 'Rome Parallel Track' medical undergraduate course is unique in Italy, there being no other completely independent experimental undergraduate medical course offered by any other of the Italian Medical Schools. A mixture of traditional and innovative methods are being tried in the course run at the University Medical School of Bari. Several experimental parallel track courses are run outside Italy. A recent report[7] deals with the strategies for the reforms introduced in eight university medical schools in the US; earlier, in 1987, there was a publication[8] produced by the World Health Organisation which advocated the revision of courses and teaching methods used in the training of all health personnel. After five years of experience with the 'Rome Parallel Track' it has become very clear to us that if teaching and learning is to become student-based it is not possible to permit teachers to cover every aspect of their subject comprehensively and exhaustively. It is necessary to identify a number of key concepts that should be covered thoroughly and which would constitute a core curriculum. This need is now abundantly clear, but the

TABLE 3
Mean scores for basic concepts considered important by all four groups of respondents.

	A	B	C	D	All Groups	Standard Error
• Acid-base balance	4.65	4.76	4.38	4.62	4.60	0.08
• Primary, secondary and tertiary prevention	4.63	4.33	4.3	4.75	4.50	0.11
• Early and timely diagnosis	4.55	4.62	4.07	4.75	4.49	0.15
• Glomerular filtration & creatinine clearance	4.45	4.42	4.3	4.75	4.48	0.1
• Statistical properties of diagnostic tests	4.65	4.47	4.15	4.6	4.46	0.11
• Hormones as primary physiological messengers	4.35	4.52	4.23	4.75	4.46	0.11
• Hypoxia, hypoxemia, ischaemia and their mechanisms	4.6	4.71	4.00	4.56	4.46	0.16
• Corticosteroids, physiological & pharmacological effects	4.35	4.19	4.33	4.66	4.38	0.1
• Basic mechanisms of action of drugs	4.8	4.14	4.00	4.6	4.38	0.19
• Drugs active on the coronary and brain vessels	4.3	4.23	4.44	4.46	4.35	0.06
• Aspirin and other NSAI	4.35	4.28	4.22	4.53	4.34	0.07
• Emunctory functions - barriers to disease	4.55	4.14	4.23	4.37	4.32	0.09
• Familial and heredity factors	4.42	4.09	4.15	4.62	4.32	0.12
• Selectivity of antimicrobial drugs	4.3	4.23	4.00	4.6	4.28	0.12
• Concept of reanimation (resuscitation)	4.00	4.00	4.23	4.6	4.20	0.14
• Digitalis and its effects	4.2	4.00	4.11	4.33	4.16	0.07
• Fate of drugs in the healthy elderly, and in patients	4.15	4.00	4.00	4.5	4.16	0.12
• with kidney and liver diseases						

TABLE 4
Mean scores for basic concepts considered important by three of the four groups of respondents.

	A	B	C	D	All Groups	Standard Error
• The immune response	4.6	4.71	3.88	4.3	4.37	0.19
• DNA, RNA and their functions	4.45	4.6	3.69	4.62	4.34	0.22
• Pain (severity, afferent pathways and ultimate pathogenic mechanisms	4.65	4.23	3.76	4.62	4.31	0.21
• Drug resistance of micro-organisms	3.95	4.19	4.3	4.73	4.29	0.16
• Homeostasis and its mechanisms	4.35	4.47	3.76	4.56	4.28	0.18
• Glucose & glycogen metabolism	4.45	4.42	3.76	4.37	4.25	0.16
• Homeostasis and its control	4.45	4.28	3.6	4.68	4.25	0.23
• Imaging: techniques and their integration	4.45	4.61	3.44	4.5	4.25	0.27
• The transport of 0,	4.45	4.19	3.76	4.56	4.24	0.18
• Concept and functional meaning of enzymes	4.2	4.38	3.61	4.62	4.20	0.22
• Drug interaction	4.00	4.23	2.76	4.2	4.20	0.35
• Infection & disease	4.55	4.19	3.84	4.2	4.19	0.14
• Tumour markers	4.15	3.85	4.44	4.3	4.18	0.13
• Vital parameters and their values	4.6	4.14	3.58	4.43	4.18	0.22
• The renal counter-current exchange system	4.00	4.33	3.76	4.62	4.17	0.19
• Transmission of infection & infestation	4.1	4.15	3.84	4.53	4.15	0.14
• Integrated control of systemic blood pressure	4.3	3.71	4.15	4.43	4.14	0.16
• Receptor mechanisms	4.2	4.04	3.69	4.5	4.10	0.17
• Structure of the gene as molecular base of genetic project	4.45	4.14	3.46	4.37	4.10	0.22
• Proteins as primary constituents of the organism	3.9	4.05	4.07	4.37	4.09	0.1
• Sensitive receptors	4.25	3.8	4.00	4.31	4.09	0.12
• Oncogenes and oncosuppressor genes	4.00	4.04	3.84	4.18	4.01	0.07
• Invasivity & metastactic potential of tumours	4.05	3.61	4.11	4.3	4.01	0.15
• The proteins as molecular base for normal and mutated phenotypes	4.15	4.00	3.38	4.43	3.99	0.22
• Synaptic transmission	4.15	4.04	3.07	4.25	3.87	0.27
• ATP function	4.2	4.00	3.07	4.06	3.83	0.26
• Drugs and toxic substances	4.6	4.28	3.55	4.4	3.79	0.23

TABLE 5
Mean scores for basic concepts considered important by two of the four groups of respondents.

	A	B	C	D	All Groups	Standard Error
• Defences against micro-organisms						
• Non-cardiac chest pain	4.2	3.95	3.84	4.43	4.11	0.26
• Clinical guidelines	3.85	4.09	3.76	4.62	4.08	0.39
• Mutation and genetic variability	3.8	4.00	3.69	4.71	4.05	0.46
• Screening of genetic disease	4.1	3.95	3.92	4.18	4.04	0.12
• Concepts of force, pressure, tension, resistance and flow	4.2	3.95	3.53	4.31	4.00	0.35
• Pathogenic and opportunistic micro-organisms	4.15	3.95	3.46	4.37	3.98	0.39
• Tolerance and drug dependence	4.1	3.76	3.66	4.3	3.96	0.3
• Mechanisms controlling inflammation	4.15	3.85	3.55	4.26	3.95	0.32
• Interactions between phenotype and environment	4.00	3.57	3.84	4.37	3.95	0.33
• Osmolarity and its control mechanisms	4.1	3.9	3.36	4.43	3.95	0.45
• Immunomodulators and immunosuppressors	4.1	3.9	344	4.26	3.93	0.36
• Consciousness & confusion	4.00	3.95	3.15	4.62	3.93	0.6
• Transmissions of signals from the nervous system	4.15	3.85	3.3	4.37	3.92	0.46
• Calcium homeostastis	4.05	3.85	3.38	4.31	3.90	0.39
• Natural history of disease	4.15	3.9	2.92	4.40	3.84	0.65
• Feedback systems	3.5	4.09	3.15	4.62	3.84	0.65
• Host-micro-organism interactions	4.05	3.65	3.38	4.18	3.82	0.37
• Placebo effect	4.00	3.8	3.3	4.18	3.82	0.38
• Ortho- and parasympathetic balance	4.1	3.8	3.07	4.18	3.79	0.51
• Concepts of cost-benefit and cost-effectivenes	4.00	3.8	3.3	4.00	3.78	0.33
• Clinical trials	4.00	3.76	3.3	4.06	3.78	0.35
• Evidence-based medicine and its applications	4.16	3.78	3.0	4.18	3.78	0.55
• Origin & reabsorption of extracellular fluids	3.85	4.04	2.84	4.37	3.78	0.66
• Enterohepatic circulation of biliary salts	3.5	3.47	4.00	4.00	3.74	0.3
• Grading & staging. Activity indexes of disease	4.05	3.52	2.92	4.31	3.70	0.62
• Control of body temperature	4.1	3.8	2.84	4.00	3.69	0.58
• Cell cycle & division	4.05	3.95	2.53	4.18	3.68	0.77
• Radiation damage & radioprotection	4.00	3.28	3.33	4.00	3.65	0.4
• Posture & its control	4.1	3.28	2.92	4.00	3.58	0.57
• The hemispheric lateralisation	4.2	3.4	2.53	4.00	3.53	0.75

choice of which key concepts to include in the list is not so clear.

The results of this study indicate that the opinions about what is important to include in the core curriculum depend on who is asked. Recent graduates seem to think that almost everything is important, perhaps because they have not yet acquired the necessary professional experience to know which of the concepts are most useful for everyday medical practice. On the other hand the GPs, who work in the front line of clinical medicine, are more sceptical about the necessity to know everything. For them it is clearly important that the medical undergraduate learns the essential concepts, particularly those which are most frequently useful at the first contact between a patient and the medical profession.

The observed variability in the proportion of key concepts scored as ≤ 4 between the four groups of respondents may have a number of different explanations. The higher percentage recorded in the recent graduates (group D) might be attributed to their not having yet acquired a perception of the importance of the hierarchy of items, and in fact this was mirrored by the low values of the GPs (group C). However, the higher level of concordance between the 'parallel track' teachers (group A) and the recent graduates (group D), might suggest that, having only just obtained their degree, recent graduates seem to appreciate the importance of the acquisition of numerous concepts. In fact, in comparison with group D, respondents of group B, and especially C, seemed to undervalue certain items that might be considered a prerequisite for modern clinical reasoning, such as its statistical, epidemiological and ethical background, or a more adequate patient-doctor relationship.

Of the 27 highly scored concepts of an American study,[5] 14 received a score of ≤ 4 by two or more groups in the present study. The absence of significant scoring differences between basic scientists and clinicians also confirmed the assertion of the American authors of a high degree of agreement in the presumed relative importance of the concepts selected. As they said, this suggests that 'there are *not* two cultures here', one reflecting basic science and the other clinical practice.[5]

The majority of university teachers considered that the key concepts which emerged from the present study to be of help in planning a core curriculum. The major aim in deriving a set of basic concepts remains that of focusing the attention of both teachers and students on selected topics that should receive special attention. Of course, such a set cannot represent a curriculum in itself, nor should it exempt students from their responsibility to enlarge their store of medical information for themselves.

NOTE

The full list of the 202 original basic concepts and the corresponding scores may be obtained from the Secretariat of the Rome Parallel Track, the Faculty of Medicine, University *La Sapienza*, Viale del Policlinico, 00161 Rome, Italy.

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