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Change in knowledge of general practitioners during their professional careers

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In this study the level of knowledge of general practitioners (GPs) in different stages of their career, from the undergraduate level onwards to more than 20 years after certification, has been investigated. The total body of knowledge as well as the knowledge about different aspects of care was established. Participants were 108 medical students, 445 postgraduate trainees in six different stages of their training and 351 GPs with 5 to more than 20 years of experience. They all took the same written test, designed to assess knowledge closely related to patient care. An increase in test score was found from the start of postgraduate training onwards followed by a decrease starting 5-10 years after certification. The curves for the different aspects of care varied. It is concluded that the body of knowledge of GP-trainees increases during postgraduate training and reaches the level of knowledge of GPs who are less than 10 years certified. From 10 years after certification onwards the knowledge decreases as well as changes over time. The latter had also been found in two American studies relating to the knowledge of certified GPs and internists. The results seem important for the organization and content of postgraduate training and continuous medical education.

Introduction

The total body of knowledge of medical students increases gradually during education.^{1,2} This trend is assumed to continue after graduation, due to the acquisition of knowledge related to new developments in medical science and technology. Surprisingly, however, a decrease in the total body of knowledge of certified doctors with increasing years of experience has been reported for American GPs³ and internists.^{4,5} For the internists this decline could be explained by lower scores of the more experienced (older) doctors on items concerning facts and views that had emerged in the years after their certification.⁶ General internists had a higher total test score than sub-specialists, while the latter scored better on the category 'new knowledge' in the field of their subspecialty. This indicates that the body of knowledge of practising physicians changes with the content of their professional occupation: knowledge relevant in the context of daily work may be revised and elaborated as opposed to knowledge that is scarcely applied. This interpretation fits well within the theory

on the development of medical expertise, in which the quality of the diagnostic process is thought to be largely dependent on the frequency of patient-encounters in a certain field.⁷

These findings elicit a variety of additional questions about the relation between education, experience and knowledge acquisition. How does the level of knowledge reached at the end of undergraduate and postgraduate education compare with that of certified practitioners? Do changes in level of knowledge in a homogeneous group of practitioners apply equally to the whole professional domain or does this change vary for different aspects of care?

Research questions and hypotheses

In the study reported here, changes in knowledge of Dutch general practitioners have been investigated. The analyses focus on:

- the overall level of knowledge of GPs at different stages of their professional careers from the last stage of undergraduate education onwards;
- the level of knowledge for separate aspects of general practice care which are assumed to be important in the context of general practice and the professional development of GPs.

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The following five aspects were thought to be of special importance.

1. *Recent versus old knowledge.* If GPs show similar results to internists, a maintained level of 'old knowledge' and a decreasing level of 'recent knowledge' with years of experience should be found.

2. *Knowledge related to diagnosis versus treatment.* During undergraduate education the knowledge about diagnoses is paramount, whereas knowledge of the treatment of diseases is mainly acquired after graduation. This may be reflected in a more pronounced increase in scores on treatment than on diagnosis during postgraduate training. The continuous developments in pharmacotherapy may be reflected in the level of knowledge maintained after certification.

3. *Knowledge related to serious versus not serious conditions.* It is expected that knowledge about 'serious conditions' shows no decline after certification, being vital in matters of life and death.

4. *Knowledge related to chronic versus acute illness.* The surveillance of chronic illness is an important aspect of care to which the GPs devote a substantial part of their time. Students and trainees, on the other hand, have less opportunity to follow the course of chronic illness during longer periods of time.⁸ This may be reflected in certified GPs' relatively high level of knowledge about chronic illness compared to the level of knowledge of students and trainees.

5. *Knowledge whether or not related to Practice Guidelines.* A recent development in the Netherlands is the introduction of 'Practice Guidelines' in general practice. They reflect the state of the art on a given subject.⁹ It is expected that trainees' knowledge about the Practice Guidelines is better than that of certified practitioners because the Guidelines are incorporated in the theoretical part of their training.

Methods

Design

This study uses a cross-sectional design. The same knowledge test was administered to groups of GPs at different stages of their professional career.

Sixth-year students in the undergraduate family medicine clerkship, trainees in their two-year postgraduate training and GPs, both postgraduate trainers and non training GPs, participated (see Table 1).

Complete groups of trainers were requested to participate as well as several groups of GPs who had registered for continuous medical education (CME-) programmes. Therefore, the GP group should be regarded as a positive selection from the total population of GPs in the Netherlands.

Instruments

The knowledge test used in this study was at the time of this study administered to all trainees in general practice

TABLE 1 *Participants of the February 1992 knowledge test (n = 904). Groups per career stage and number of individuals per group*

Groups of participants	Number of individuals
Students	108
Trainees	445
1 month in training	85
5 months in training	103
9 months in training	46
13 months in training	55
17 months in training	99
21 months in training	57
General practitioners	351
0-5 years of experience	22
6-10 years of experience	68
11-15 years of experience	99
16-20 years of experience	109
>20 years of experience	53

in the Netherlands three times a year during the two years of their training (from September 1994 this training has been extended to three years). The test is designed to record progress during training and is therefore set at the level of the qualified GP. Each test consists of approximately 80 patient cases derived from daily practice with a total of 160 case-related items.^{10,11} The response format is of the true-false type with an additional 'I do not know' option. To discourage guessing, the final score is expressed as the percentage correct minus incorrect answers, the 'I don't know' option being disregarded. After test administration, items which are highly criticized by the participants and which have bad psychometric characteristics are eliminated.

The validity and reliability of the test have been studied extensively and will be reported elsewhere (Van Leeuwen *et al.*, under editorial review). The conclusions from these studies are, that the test has a satisfactory content and construct validity and a reliability above 0.89 for rank ordering of groups of more than 30 individuals.

Definitions for the different aspects of care were first formulated and then tested for ambiguity. 'Recent knowledge' in this study was defined as being 5 years old or younger. Four GPs were asked to assign the items of the knowledge test to the defined categories. Consensus among all four raters determined the final selection of items for the different categories. Items for which no consensus was reached were omitted. Therefore, the number of items included in the analysis may vary for the different categories from the total number of 146 test items. Only seven items were classified as 'recent knowledge', which is why the mean scores on 'recent' and 'old' knowledge were omitted in the analysis.

In February 1992 the knowledge test was administered to all groups of participants. The students,

trainees, trainers and a minority of the GP non-trainers took the test under standard test conditions (supervision). Those who did not were explicitly requested not to consult the literature. The mean test score did not vary for the two conditions.

Analysis

Per group of respondents the mean score and 95% confidence interval (twice the Standard Error, SE) of the mean were computed for each set of items. Differences in item-difficulty do not allow comparison of the absolute scores on the different subtests. Therefore, only differences in mean score between career stages for every separate category are reported.

Results

Figure 1 shows the overall mean test score for all career stages. Non overlapping confidence intervals of group means indicate statistical significance. Trainees at the start of training score significantly better than undergraduate students, whereas trainees at the end of training score as high as the best scoring group of certified

GPs (5-10 years after certification). During post-graduate training the scores gradually increase with the exception of a 'plateau' from the fifth to the thirteenth month of training. Figures 2-5 present the group mean scores and 95% confidence intervals of all groups on the different subtests. There is an increase in knowledge on each of these subtests during training, all with more or less the same 'plateau', whereas the curve after certification varies.

For knowledge about diagnosis as well as treatment the maximum mean score is reached at the same stage, the end of training. The increase from undergraduate to graduate level, however, is more pronounced for treatment than for diagnosis. After certification the mean scores on treatment remain more or less constant, whereas the scores on diagnosis show a slight decline.

The graph for knowledge about serious conditions shows a somewhat capricious course during post-graduate training. The top is not reached until 5-10 years after certification, followed by an evident decline. The graph for knowledge about non-serious conditions closely follows the course of the total test score.

The graph for knowledge about chronic diseases shows an increase during training similar to that of the total test score, followed by a 'plateau' after certification, whereas the knowledge on non-chronic diseases shows a curve fairly identical to that of the total test score.

The course of knowledge about the Practice Guidelines shows a dramatic increase during postgraduate training and a considerable decrease thereafter.

Discussion

The cross-sectional design of the study does not, in fact, allow longitudinal inferences. However, terms like 'increase' and 'decrease' have been used for the sake of simplicity. The results show that the level of knowledge of GPs during their professional career follows the same course as is demonstrated for American GPs and internists: a decline after certification. The fact that the par-

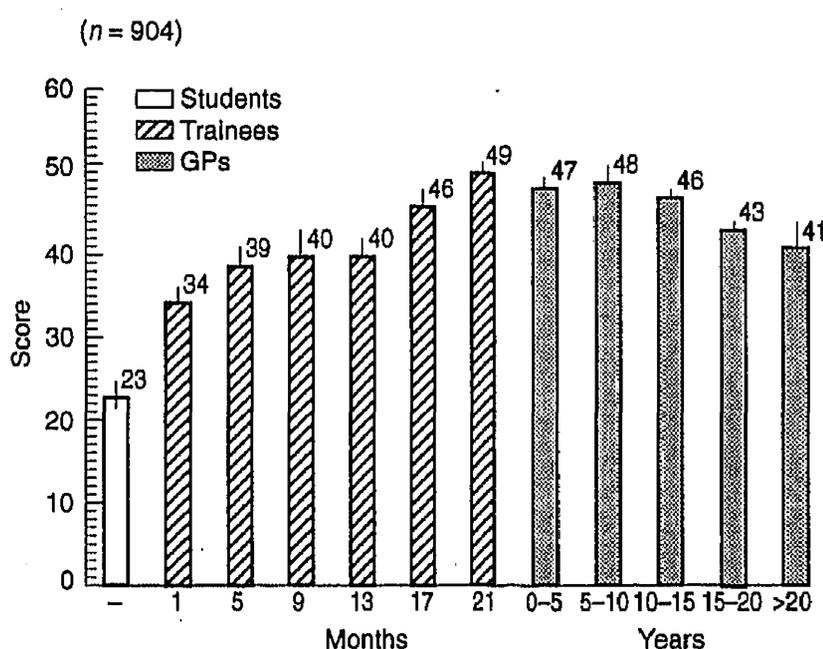


FIGURE 1 Total test mean score (146 items)—percentage correct minus incorrect—for groups of students, trainees and general practitioners (n = 904).

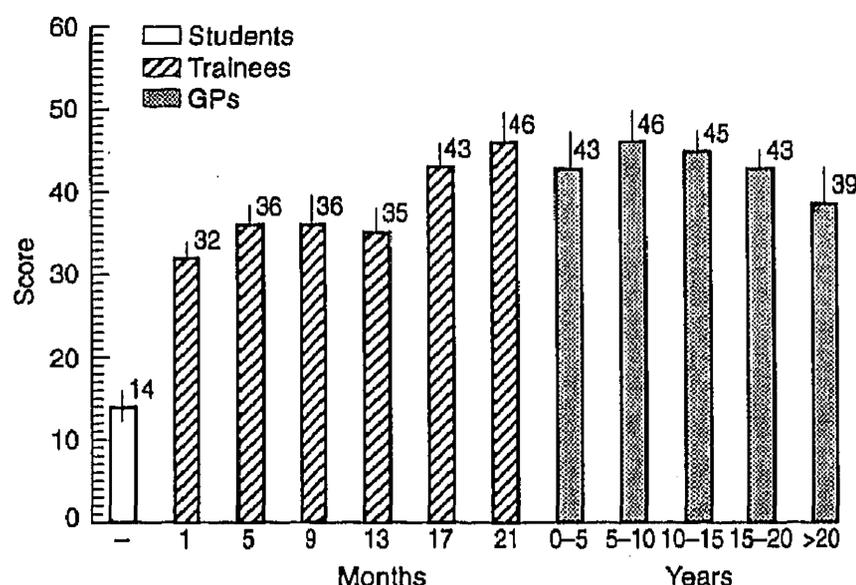
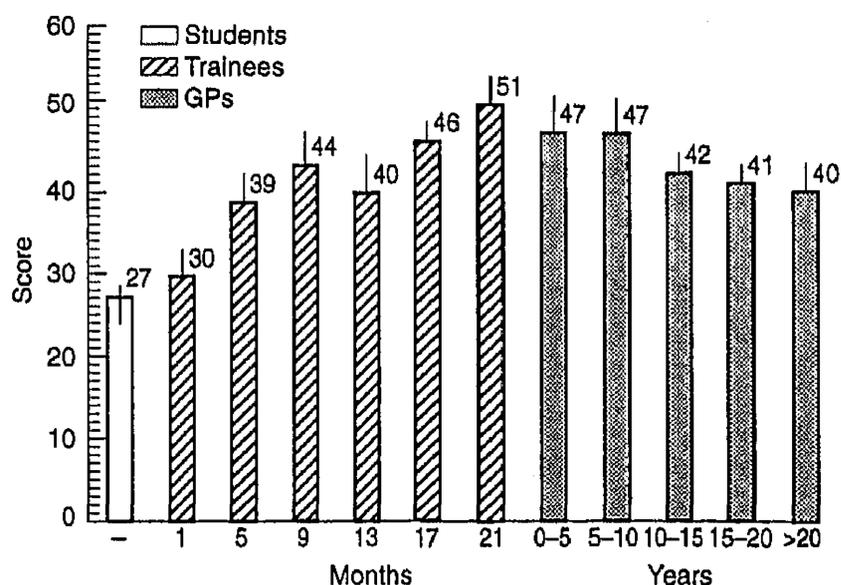


FIGURE 2 Mean score on the categories 'diagnosis' (53 items) and 'treatment' (80 items)—percentage correct minus incorrect—for groups of students, trainees and general practitioners (n = 904).

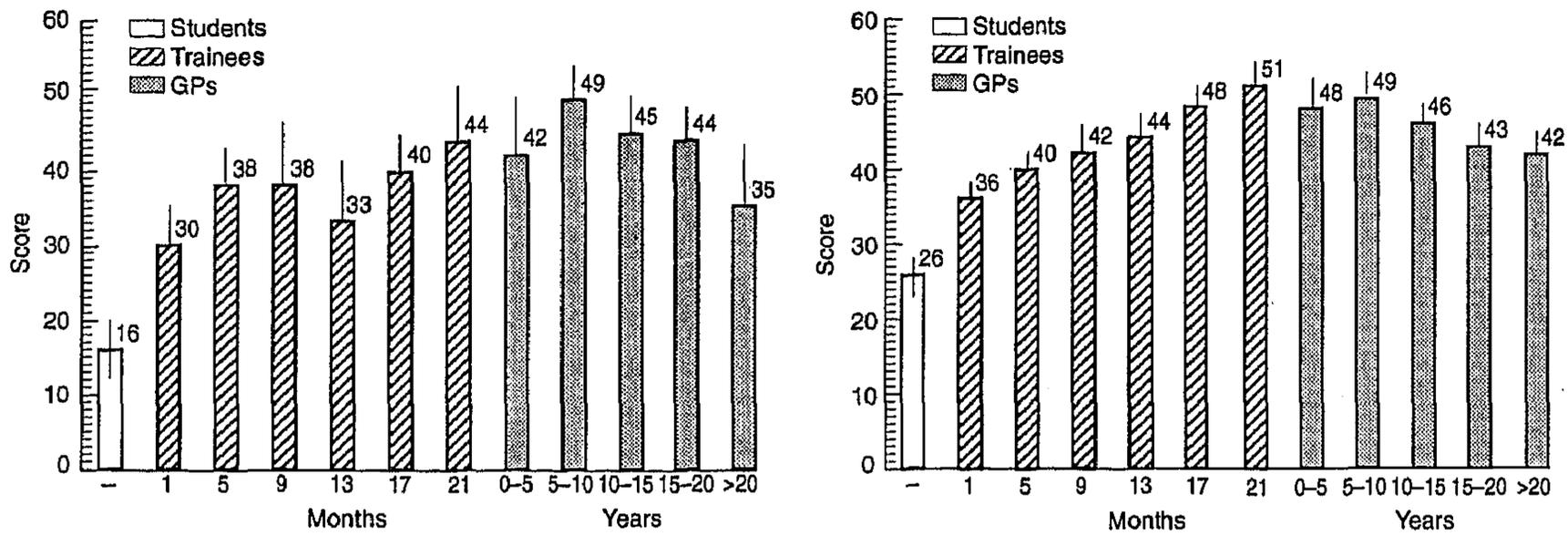


FIGURE 3 Mean score on the categories 'serious conditions' (15 items) and 'non serious conditions' (105 items)—percentage correct minus incorrect—for groups of students, trainees and general practitioners (n = 904).

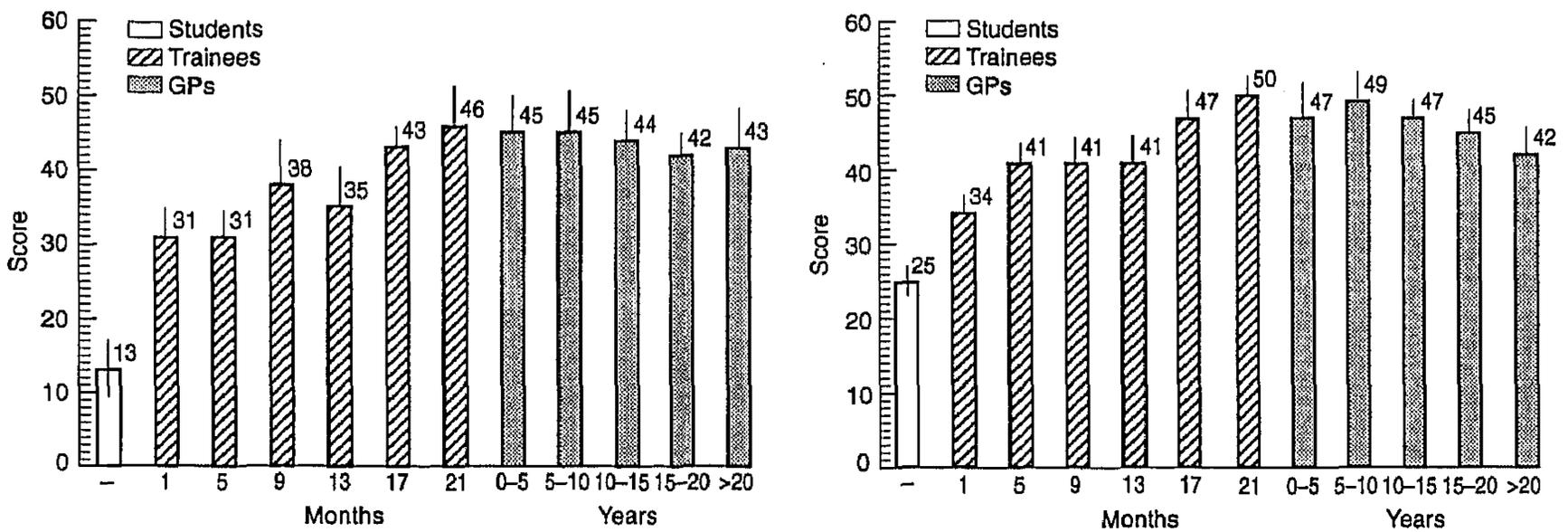


FIGURE 4 Mean score on the categories 'chronic illness' (30 items) and 'acute illness' (116 items)—percentage correct minus incorrect—for groups of students, trainees and general practitioners (n = 904).

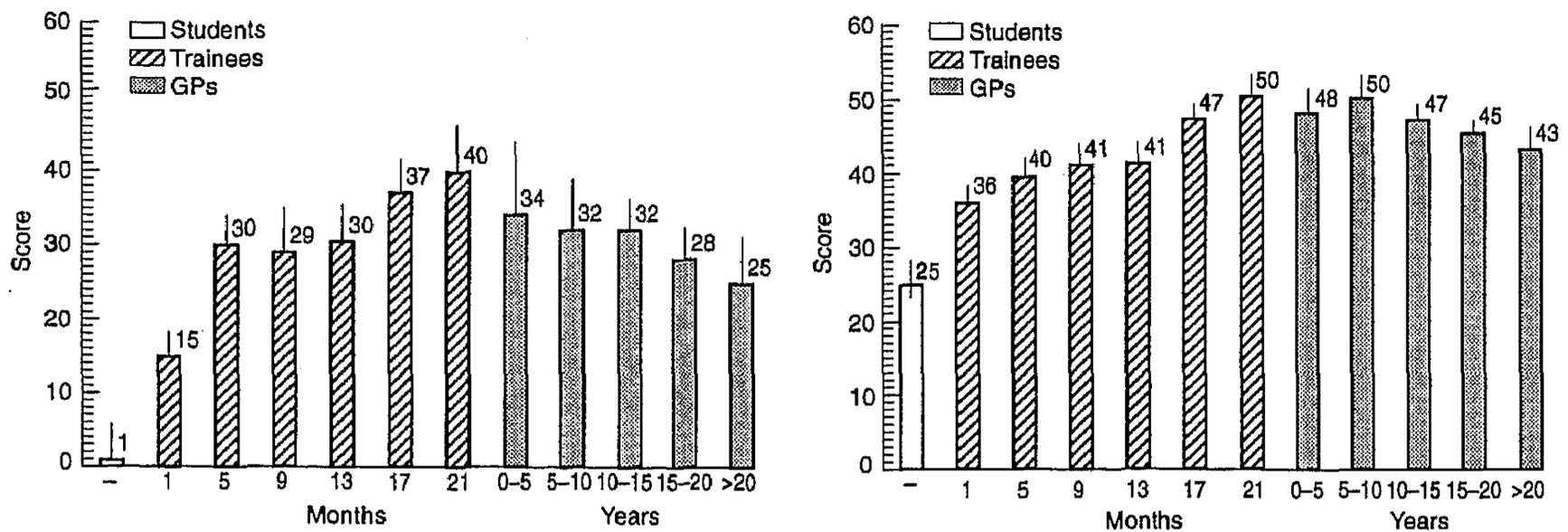


FIGURE 5 Mean score on 'items related to Practice Guidelines' (16 items) and on 'items not related to Practice Guidelines' (130 items)—percentage correct minus incorrect—for groups of students, trainees and general practitioners (n = 904).

participants possibly form a positive selection from the population of Dutch GPs strengthens this conclusion. This study shows that the decline is preceded by an evident increase in knowledge during postgraduate training resulting in a level of knowledge at the end of training that equals that of certified GPs. As far as knowledge is concerned, postgraduate training seems to contribute substantially to the competence of the recently certified practitioner. The results on the different subtests con-

firm this conclusion: the maximum mean score for all the different issues is reached at the end of training with the (predicted) exception of knowledge about 'serious conditions'. The maximum level of knowledge about 'diagnosis' does not precede that on 'treatment', which is counter to our hypothesis. The extent to which the different 'sorts of knowledge' are acquired or maintained after certification varies. One possible explanation is that some knowledge loses its value for daily

practice. Pattern recognition based on extended experience may reduce the need of factual knowledge.¹² However, there is definitely a 'generation effect'. The knowledge of elder practitioners may be deficient in certain fields due to ignorance of the present-day state of the art when they were in training. Limited time for CME further explains the present findings. However, it should be kept in mind that written tests, however content-valid, may insufficiently represent the reality of daily practice, thereby putting the experienced practitioner at a disadvantage.¹³

The graph for chronic diseases may indicate that the level of knowledge is related to the incidence of corresponding patient encounters. This implies that selecting patients for students and trainees may be of help to enhance their knowledge in a certain area. Simulated patients with, for example, serious conditions with a relatively low incidence in general practice, may play a role in the maintenance of the competence of certified GPs. In general we may conclude that studying the changes in the level of knowledge of medical professionals during their life-long career is of value to the development of theories on knowledge acquisition as well as to curriculum planning for postgraduate training and CME.

A longitudinal study might well have additional value but does not seem feasible, given the fact that it would take 30 years or more to accomplish. Further research should concentrate on facilitating and impeding factors for the acquisition of knowledge before and after certification.

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