Chapter 16

Can Future Poor Performance be Identified during Selection?[1]

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Abstract. *Selection is often invoked as an effective means of improving the overall performance of doctors in a wide range of areas. This chapter shows that the effects of selection are surprisingly limited, in part because the effective selection ratio for medical school is very low, with only about two candidates for each place, and also because as one selects on more and more criteria so the impact of each one necessarily falls. Instead it is suggested that training is a far more powerful method of altering the behaviour of medical students and doctors, and thereby reducing the overall rate of poor clinical performance.*

16.1. Introduction

Avoiding poor performance by better selection of medical students or medical specialists is an immensely attractive idea; more rigorous, better targeted selection might, at one fell stroke, reduce poor performance and raise overall standards of medical care. Such at least is a frequently used argument, which has been put forward most recently by Rosenthal [1] in her book, *The incompetent doctor*:

> *"The criteria for entrance to medical school are potentially the most powerful tools for effective self-regulation that the profession has. The characteristics of those admitted to medical education are a key basis for predicting future behaviour"(p.136)*

And Rosenthal's final recommendations included,

> *"A more sophisticated medical school selection process that identifies the 'difficult' personality and the problem prone" (p.145).*

1 This chapter is based on, and is an extension of, one previously published in the context of reducing medical accidents [8].

Likewise the lay public has a persistent belief that selection is the key to weeding out inappropriate behaviour in doctors, seen in a single recent example written by a journalist:

> *"However much they try and teach bedside manners in the medical schools these days, I reckon it comes down to personality in the end. Unless we can somehow screen out the supercilious, the unimaginative, and the cold eyed before they hit the wards, the chances of being dealt with kindly when our lives are on the line will remain cruelly arbitrary"[2].*

However, such proposals invite a host of difficult questions. Does selection mean searching for doctors of higher general competence, or simply seeking to weed out a few 'bad apples' whom are implicitly assumed to be responsible for poor quality care? Is poor performance a stable individual characteristic? In other words, are some individuals naturally irresponsible, socially inept or especially prone to errors and poor judgement? Even if such people can be identified, can they be identified at seventeen years of age, prior to medical school entry? And if they can, is it justifiable to reject such an applicant solely on those grounds when they might later change their attitudes and behaviour, and becomes a competent or even excellent doctor?

There is little empirical research to either support or reject the view that poor performers could be excluded at the selection stage, although there is relevant work in related areas. We will argue that attempts to alter medical selection are premature until the underlying assumptions have been thoroughly examined. The feasibility of selection as a policy instrument requires careful investigation, in respect of both the short and long-term effects and the theoretical and practical limitations. We argue that although selection procedures in medicine show great scope for improvement, selection to exclude poor performance *per se* should not be the priority. Instead attention should be concentrated on characteristics which allow the training of a competent doctor. At the undergraduate level we will call them *canonical characteristics* - generic abilities which provide an adequate substrate for medical education, general training and continuing professional development. At the post-graduate level they will vary by speciality. Identification, measurement and validation of these characteristics should allow the development of selection procedures founded on a secure theoretical and empirical basis.

This chapter will firstly ask whether any personality measures might be predictive of poor performance. We will then present a theoretical argument to identify the limits of successful selection and compare the benefits of selection with those of training. These arguments will be illustrated with hypothetical examples of different selection strategies for entry to medical school. The same basic arguments however apply in respect of selection for a particular specialty or at any career point.

16.2. The Poorly Performing Doctor

The nature of poor performance and the various measures to identify and deal with poor performance are discussed throughout this book and we will not discuss these matters in any detail. However it is necessary to briefly consider the characteristics of a poorly performing doctor, before discussing those characteristics that might predict poor performance. A recent study [3] allows us to identify the main themes.

The Netherlands Health Inspectorate carried out a retrospective investigation in 21 hospitals examining the nature and incidence of malfunctioning doctors. Over a five year period 19 hospitals reported a total of 93 malfunctioning doctors. The nature of the malfunctioning, as reported by the hospitals themselves, is shown in Table 1. We have grouped some of the items in Lens & van der Wal's original table to bring out some of the core characteristics of poor performance.

Table 1 shows that the principal characteristics that cause problems are: (i) Medical and technical errors of judgement; (ii) personality factors of various kinds; (iii) inability to work in a team; (iv) poor communication and lack of social skills; and (v) mental health problems. Their 'other' category includes many descriptions, such as intimidation of the entourage and failure to inform patients, which would also fall under one or another of these broad categories. These categories are not necessarily distinct or mutually exclusive. Personality problems or mental health problems may lead to poor communication and errors of judgement. However, for our purposes, the exact definition of poor performance is not important. It is sufficient that we have an indication of the kinds of personal characteristics that we might be attempting to select or to avoid at the point of selection.

The avoidance of poor performance by improved selection requires that the likelihood of poor performance is a relatively enduring individual characteristic. If such a tendency is not fairly stable then selection at age seventeen will have little influence on behaviour twenty or thirty years later. There are therefore two crucial issues to be addressed: (i) Identifying those characteristics that might predict poor performance and (ii) Considering whether they might be detectable at age seventeen, which would require that long term stability of that particular trait in addition to a sensitive and reliable method of detection. We will briefly consider this latter issue as, without some evidence of long term stability of individual characteristics, the enterprise is doomed from the start.

16.3. Stability of Personality and Performance

The best evidence of long-term stability of individual characteristics is in the field of intelligence. Intelligence is a relatively stable personal characteristic, in part genetically determined, and is a good predictor of academic achievement and other skills relevant to medicine. However as intelligence is already used as a predictor in medical education, examination performance being at least a surrogate for intelligence, other characteristics are clearly needed to exclude poor performance at

a later date.

Models of personality postulate a number of key underlying traits, the exact number varying according to different theories. The five factor theory [4] encompasses most of the previous theories and postulates five underlying dimensions: Extraversion, Neuroticism (emotional stability), Openness (seeking out and appreciation of experience), Agreeableness (primarily concerning interpersonal relationships) and Conscientiousness (organization, motivation and persistence). On at least some of these dimensions there is strong evidence for long term stability [5] and a genetic basis for the trait [6]. McCrae and Costa [4]summarize the current evidence as follows:

"In the course of thirty years most adults will have undergone radical changes in their life structures. They may have married, divorced and re-married. They have probably moved their residence several times... And yet, most of them will not have changed appreciably in their standing on any of the five dimensions"

The point was brought home to us by a recently retired professor who had attended his forty year medical school reunion and described how although much older, the personalities of the individuals had changed very little; "the most extravert were still the most extravert, the most neurotic still the most neurotic".

Table 1. Malfunctioning of specialist in 21 hospitals in North Holland (1987-1992). Adapted from Lens and Van der Wal [3]

Categorisation of poor performance	Frequency	Type of malfunctioning
Errors of judgement & poor quality care	25	Medical & technical errors (15) Superfluous diagnostic tests (3) Negligence (7)
Personality factors	13	Incompatibility of temperament (8) Fraud (3) Sexual intimidation (2)
Team relationships	14	Inability to work in a team (14)
Communication & Social skills	6	Lack of social skills (6)
Mental health	19	Addiction to drugs/medicines (10) Alcoholism (5) Other psychiatric problems (3) Depression (1)
Other & not stated	16	Various

Some provisos need to be attached to such statements in this context. The five dimensions, although important, only encompass a few of the personal characteristics of potential relevance to poor performance in medicine. In addition while evidence for stability across time is strong, people's behaviour changes markedly in different situations. Thus behaviour and personality within the family may be very different from in the clinic. Nevertheless the potential relevance to medicine is seen by the recent conclusion that across most job-types and performance measures, Conscientiousness is a reliable predictor [7]. It is, therefore, at least feasible that selection on some personal characteristics might have value as exclusion criteria, though these might not only include the classical dimensions of personality. What characteristics might we need to examine?

16.4. Potential Predictors of Poor Performance

Even a cursory examination of Table 1 shows the difficulty of selecting for all aspects of poor performance, even allowing that their might be an overlap between categories. An aggressive and arrogant personality for instance would probably be a poor team worker and might alienate and distress patients, so perhaps aggressive and arrogant individuals should be excluded. However, a lack of empathy with others, might have similar effects. Already we are considering two possible personality characteristics that might need to be identified, and excluded, in selection. Inadequate social skills, perhaps stemming from extreme shyness, is another potential predictor. Poor performance on medical tasks has multiple causes, but consistently poor judgement and decision-making would certainly be a candidate as a predictor with potential long-term stability. Predictors of mental health problems are many and various, including a family history of depression, addiction or other psychiatric problems or a disturbed upbringing. These too are potential predictors of later problems. Yet, even if it were feasible, it might be unfair to exclude people on the basis of their background who might, through their own efforts, overcome initial disadvantage to enter medical school and become excellent doctors. And individuals do reject their own background sometimes, as is shown in the frequently made observation that the children of alcoholics are also more likely to become teetotallers.

The broad and varying nature of poor performance, even when grouped into five major categories is therefore matched and even exceeded by the still broader range of potential predictors of poor performance. Empirical work might narrow the search to a few fundamental predictors, but further problems would remain. Would all the correlates of poor performance both be revealed as causes and have the necessary long-term stability that is required for selection to operate? Furthermore would it be possible to identify these predictors reliably and validly. In medicine the answers to these questions are entirely unknown, but we can explore some of the potential problems and pitfalls by examining a parallel case of the causes of poor performance, the search for predictors of accident involvement. As many cases of

poor performance come to public attention primarily because of a medical accident or mishap, and poor performers almost by definition have more mishaps, predictors of accident involvement may also predict poor medical performance.

Early studies on the causes of accidents searched principally for an 'accident-prone personality' liable to accidents throughout a lifetime. If that personality could be identified then, at least in industrial settings, accident-prone people could be excluded during the selection process and assigned to other work. The search for a 'poor performance prone' personality in doctors parallels the search for accident-prone individuals in other contexts. We have discussed the accident prone personality in more detail elsewhere [8]. Here we simply summarize the main points and discuss the implications for our present problem.

16.5. The Concept of Accident-Proneness?

The concept of accident-proneness dates back to the studies of Greenwood, Woods and Yule [9,10] and Newbold [11] of factory accidents, who showed that workers' individual accident rates were not a random, Poisson distribution [12], but were better fitted by a negative binomial model with individuals differing in their propensity for accidents. Cobb who studied 29,531 Connecticut drivers during 1931-3 and 1934-6 found that 4% of drivers caused 36% of the road accidents [13]. Further analysis showed that, compared with those with no accidents in the same period, drivers having four accidents in 1931-3 were nearly seven times more likely to have accidents during 1934-6. Cobb claimed that:

> *"once a group as been established as being predominantly accident-free or accident-liable, its future history as a group can be predicted with astonishing accuracy from its past performance".*

However Forbes [14] emphasised that only 1.3% of drivers could thus be called 'accident-prone', and that their removal on the basis of accidents during 1931-3 would have decreased accidents during 1934-6 by only 3.7%. The problem with such studies is their confusion of two separate epidemiological concepts. *Relative risk* assesses how a factor alters the likelihood of an outcome for an individual (e.g. in hypertensives, smoking doubles the cardiovascular mortality), whereas *attributable risk*, assesses the population risk of a condition due to a factor (e.g. in a group of hypertensives, there will be seven excess deaths due to smoking per 1000 patient years). Although the relative risk of some individuals having accidents may be really quite high compared with other individuals, the attributable risk due to these individuals is only a small proportion of the total number of accidents. To put it another way, the sensitivity of the test may be high, but its specificity may be low. We shall see below that excluding poor performers in medicine has a similarly modest effect on outcomes.

16.6. Personal Characteristics Predisposing to Accidents

Although accident proneness has been discredited as a concept, road traffic accidents have been related to several personality measures, including extraversion [15,16], sensation-seeking [17], neuroticism [18], type A behaviour [19,20], and risk-taking behaviours [21], though not all studies have supported these findings [22-24]. Additionally it has been suggested that accidents are associated with increased aggression, seeking of prestige, and competitiveness [25]. We will focus on two characteristics, decision-making and social deviance, that also have potential relevance to poor performance in medicine.

Decision-making Style and Accidents

West has argued that since many accidents involve errors of decision-making, then a characteristic decision-making style might predict accident rates in particular situations, and Jensen [26] has emphasised that 80-85% of flying accidents are attributed to 'pilot error', frequently due to errors of judgement. West has found that the Thoroughness scale of his Decision Making Questionnaire (DMQ) [27,28], which assesses deliberate and logical decision-making, planning well ahead, and the working out of pros and cons, was a significant predictor of accident rates in the following two years. Although no such evidence exists within medicine itself, in our longitudinal cohort studies of medical student selection and training we have been using the DMQ for a number of years, and therefore its eventual possible utility should become apparent.

Social Attitudes and Accidents

Road traffic accidents have frequently been associated with a variety of variables which are broadly encompassed under the heading of 'mild social deviance' [29,30], the 'expression of hostile impulses' [31-35], and 'eccentricity, impulsivity or mild psychopathy' [36]. West et al. [29] found that minor social deviance (e.g. Parking on double yellow lines or not declaring cash payments to the Inland Revenue) correlated with driving speed and deviant driving behaviour, with low thoroughness on the DMQ and with accident rates. The psychological substrate of mild social deviance is not clear, but West et al. [29] suggest that it probably reflects "greater emphasis on the need to make good progress with less consideration of the adverse consequences of an accident".

Certainly there are concepts here which seem relevant to the problems experienced by a busy medical practitioner, perhaps under pressure from hospital managers or accountants, who might be tempted to cut the occasional procedural corner. There is evidence that the confidence of some junior doctors far exceeds their abilities in some areas [37], and an attitude of 'medical machismo' which leads to a determination to handle any emergency oneself (whatever the costs to the patient) has been documented for decades by medical sociologists (see, for example [38-41]). Where a

junior doctor feels that calls for assistance might be regarded as evidence of weakness or incompetence, such a tendency might be exacerbated still further.

There is therefore evidence that at least some personal characteristics might be predictive of accident involvement, and perhaps also of poor performance and problem proneness more generally, and could, in principle, be used in selection procedures. But even if some potential predictors of poor performance can be identified, many problems remain as regards practical application. We should at least be cautious about claims that better selection may be even a partial answer to poor performance in medicine. What benefits might we gain from attempting to select safer doctors? Is the project worthwhile, or could the effort involved be better directed at some other performance enhancing endeavour? The next sections consider these fundamental questions in some detail.

16.7. The Selection Process

There is an extensive literature on selection procedures, dating from the early years of the century. After a period of pessimism and decline in the 1950s and 1960s interest has grown steadily both in industry and in academic circles, and the usefulness and validity of some selection procedures has been established (see e.g. [7,42]). A great variety of selection procedures have been developed, some of the main ones being: interviews (both structured and unstructured); interviews in which candidates are asked to predict their behaviour in certain situations; tests of intellectual ability, perceptual-motor skills, personality and attitudes; tests which simulate or involve the work to be done; computer assisted tests; taking up references; and peer assessment [43]. In recent years the utility of 'biodata' (biographical data) has also been reaffirmed [44].

In establishing the validity of any selection procedure it is first necessary to define outcome measures, the desirable or essential skills or abilities which are assessed when selection procedures are evaluated. In medicine this might involve assessing clinical knowledge, diagnostic skills, technical competence and ability to communicate with staff and patients. The validity of selection is established by comparing the results of the selection with candidates' later scores on the outcome measures. Selection procedures with the best predictive accuracy are work sample tests and tests of general intellectual ability and, where applicable, psychomotor ability. Supervisor/peer assessments, assessments centres, biographical data and general mental ability are the best remaining methods. References, interviews, personality assessment and interest inventories are very poor predictors [43]. Selection for medical school is initially based on A-level results, probably a reasonable reflection of general mental ability and thus a useful part of the selection process. In the UK results in A-level examinations are the best predictors of success during selection [45,46], and they are also to some extent predictive of success later during the medical course [47,48]. Medical student selection also relies extensively on interviews and references, which are among the least valid of all selection

procedures [43]; nevertheless evidence suggests that medical school shortlisters and interviewers can at least become reliable in the judgements that they make [49-51].

16.8. Medical Student Selection and Training: A Theoretical Model

In this selection we will rehearse some of the theoretical constraints upon the process of selection that we have identified elsewhere [8,48], since they underpin any consideration of the role of selection.

The Limits of Selection

Student selection illustrates well the subtleties of a seemingly straightforward process. In essence, selection is extremely simple. A number of students, N, applies to study medicine, and a smaller number M is accepted as medical students; the figure N/M is known as the *selection ratio*. Although, in the UK at least, the selection ratio *for individual medical schools* seems to be high (between 5 and 20), the selection ratio *for the system as a whole* is approximately two because each candidate applies to four or five medical schools. We will assume in our discussion that the selection ratio is 2. This selection ratio is far lower than is generally thought to be the case; medical schools are not "blessed with an army of applicants" [52].

Consider a system using a *single criterion selection* (usually academic or intellectual ability, although other measures might be used). Typically scores will be normally distributed in the population; if 50% of candidates are to be selected then optimal selection simply involves choosing the half with the highest scores (see Figure 1).

If two criteria are used (let us say, 'academic ability' and 'ability to communicate') selection is more complex. Assume that the two abilities are uncorrelated (a condition that can always be met by considering their principal components). In figure 2a a set of individual candidates, assumed distributed as bivariate normal, is shown as points on the graph. Selection can take several forms. Figure 2b shows *inclusive selection*, in which candidates are selected only if they score above a certain level on *both* criteria, whereas figure 2c shows *exclusive selection* in which candidates are selected who score above a certain level on *either* criterion; finally, figure 2d shows *compensatory selection* in which a relatively high score on one criterion offsets a relatively low score on the other criterion. There are, of course, also selection strategies which are combinations of these methods. The addition of a second selection criterion has important effects which are different for each of the selection methods.

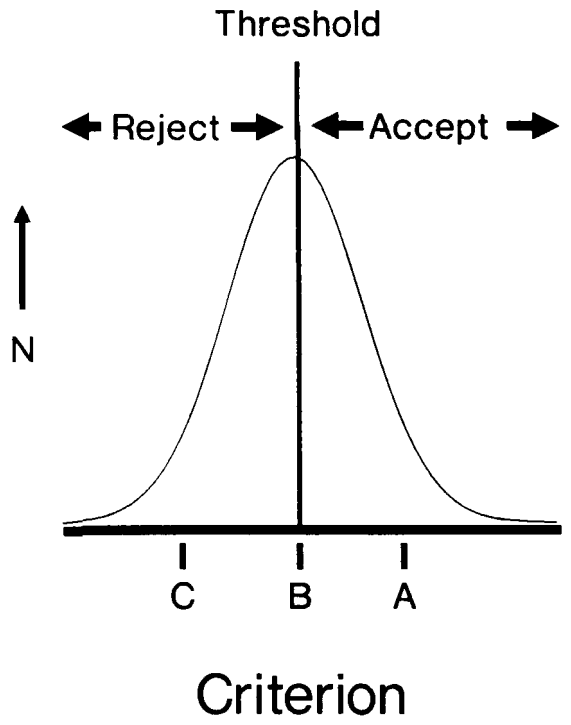

Figure 1. Selection on a single criterion. Individuals are normally distributed on the characteristic. The selection ratio is 2 and therefore the top half of the candidates are accepted. Candidate A is easily accepted, candidate C is easily rejected, and candidate B is borderline.

Inclusive Selection

The minimum standard set on *each* criterion (figure 2b) has to be *lower* than if only a single criterion had been used; thus candidate B in figure 1 is border-line, whereas candidate B2 in figure 2b is safely admitted, despite each candidate being average on each criterion. Inclusive criteria therefore reduce the average standards on each criterion, but with the advantage of ensuring that all entrants satisfy all of a range of minimum standards.

Exclusive Selection

This, in contrast, means that *some* entrants score very highly on each criterion (figure 2c) but at the expense of generally scoring very poorly on the other criterion; thus candidate B2 would be rejected as not being outstanding on *either* criterion, whereas candidate C1 is accepted because of their high score on criterion 2, despite having a score on criterion 1 which would have led to outright rejection under the single criterion selection process of figure 1. Exclusive criteria therefore result in

high variance between candidates, who always perform at a high level on at least one criterion, but typically perform poorly on the other criterion.

Compensatory Selection

This is a compromise between inclusive and exclusive selection (figure 2d). Candidates who perform *very* poorly on one criterion are only selected if they also perform *very* well on the other criterion. The method still accepts some entrants who are particularly poor on one or other criterion; thus candidate C1 is now borderline, whereas under single criterion selection they would have been rejected; and candidate A3 is also borderline despite being clearly accepted under single criterion selection.

All three methods for using two selection criteria have a single feature which is necessarily common to all; *the average performance of entrants on any one of the criteria will be less than if that criterion had been the sole basis for selection.* To put it more concretely; if one wishes to select candidates who are not only academically able but are also selected for their communicative ability, dexterity or other criterion, then the successful candidates will have lower overall levels of academic ability than would have been achieved if academic ability were the sole criterion for selection. Exactly the same arguments apply when candidates are being considered for post-graduate training in surgery, general medicine, psychiatry or other specialties.

Multiple Selection Criteria

Lists of the desirable characteristics that potential doctors should have are often lengthy [53,54]. Using multiple criteria during selection exacerbates the effects found with only two criteria and might become counter productive. Consider the case of inclusive selection, where all candidates meet minimum standards on all criteria. If 50% of candidates can be selected overall, then the top 70.7% must be selected on criterion I *and* on criterion II (fig 2b). Only the bottom 29.3% of candidates on each criterion are rejected, compared with 50% with only one criterion. With three criteria only the bottom 20.6% on criterion 1 will be rejected; and so on, as shown in table 2. As the number of criteria increases so the effect is to exclude a progressively smaller and smaller number on each criterion. The consequence is that with the low selection ratio that is found in medical student selection, *the use of multiple selection criteria cannot result in entrants who are well qualified on **all** criteria but instead only results in the rejection of candidates who score **particularly badly** on **at least one** criterion.* In effect, as one of us has put it elsewhere, "If you select on everything, you select on nothing" [48].

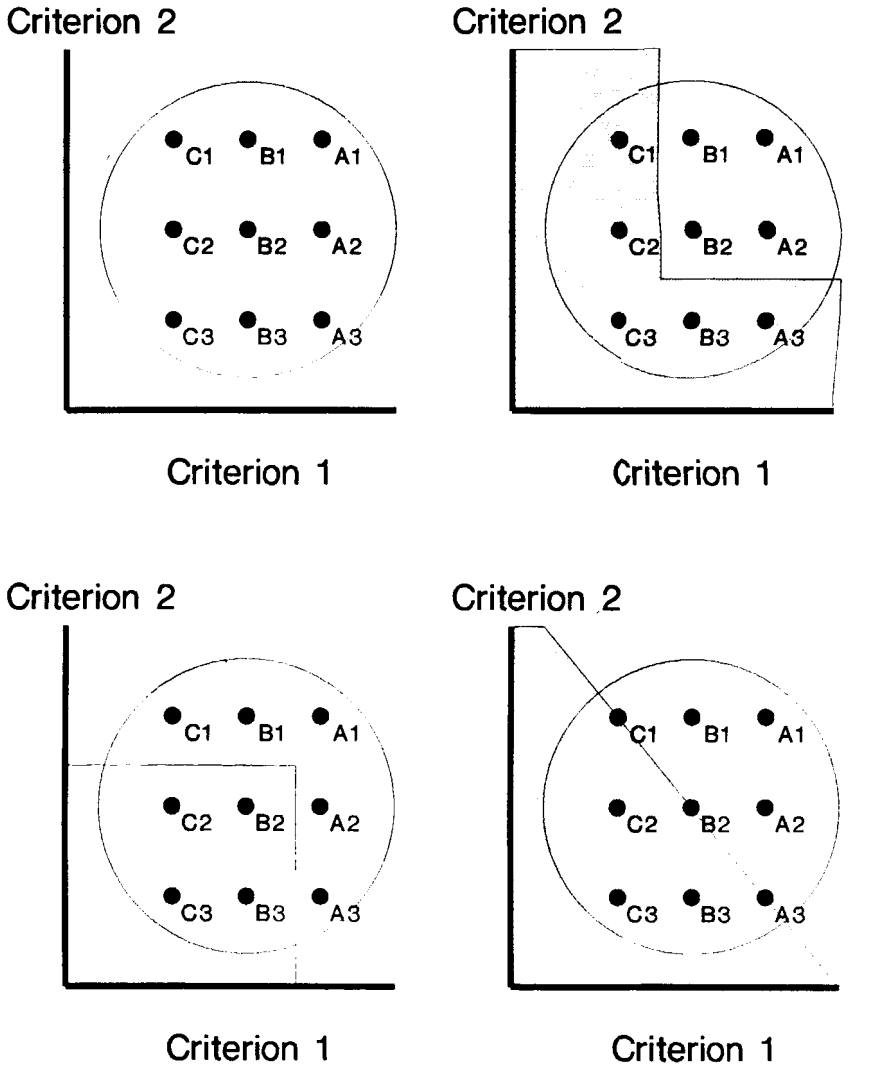

Figure 2. Selection on two independent criteria, shown on the horizontal and vertical axes. Figure (a) shows nine individual candidates as points A1 to C3. Figure (b) shows *inclusive selection* where the candidate has to score above a certain threshold on *each* criterion, and those in the shaded area are rejected. Figure (c) shows *exclusive selection* where candidates have to score highly on *one* of the criteria, and figure (d) shows *compensatory selection* where a poor performance on one criterion can be compensated by a particularly good performance on the other criterion.

Table 2. The effects of selection on multiple criteria. The table shows, for a typical selection ratio of 2, the proportion of candidates who will be rejected on each of the individual selection criteria.

Number of selection criteria	Proportion of applicants rejected on each criterion
1	Bottom 50.0%
2	Bottom 29.3%
3	Bottom 20.6%
4	Bottom 15.9%
5	Bottom 12.9%
6	Bottom 10.9%
10	Bottom 6.7%
20	Bottom 3.4%
50	Bottom 1.4%

Selection and Performance

We now consider a hypothetical example to illustrate the problems inherent in attempting to select for a particular outcome - let us say, poor clinical performance on some criterion.

Figure 3b shows the distribution of some performance-related personality measure in the population, and figure 3a shows the likelihood of actual poor performance as three times greater in those with high proneness who are two standard deviations above the mean than in those with low proneness who are two standard deviations below the mean. Although one high-risk individual is three times more likely to show poor performance than one low-risk individuals, 95% of individuals are between these extremes, and the effect of selection upon overall performance is actually very small.

Using the numerical values quoted, the bottom 10% of individuals are responsible for only 15% of cases of poor performance; and hence if those individuals were excluded from practising and replaced with others with a lower rate of poor performance, then 94% of cases would still occur. Similarly excluding from practice the bottom 20%, 30%, 40% or 50% of individuals on this scale would reduce the number of cases of poor performance to only 90%, 84%, 81% and 78% respectively.

The potential effects of selection upon performance are therefore quite small. To obtain even a 22% reduction in instances of poor performance would require 50% of applicants to be excluded (a figure equal to the selection ratio, and thereby implying selection on this single criterion alone). This result means that selection would not be occurring on any other criterion (such as academic ability) - and that, of course,

might result in *higher* rates of poor performance, for other obvious reasons.

The conclusion seems to be that any realistic personality-type measure which could be used at the time of selection for differentiating applicants with a high likelihood of poor performance would have only a small effect on overall performance and clinical outcomes. To have a larger effect it would need to preclude any other form of selection, which might itself adversely affect performance. This does not mean that selection is unimportant in relation to poor performance, only that excluding poor performance *per se* should not dictate the selection criteria.

The Effects of Training

While the effects of even accurate selection are modest, the effects of training, in which all students participate, may be substantial. Medical students enter medical school with almost zero ability to practice medicine (excluding a few rudimentary skills at first aid). Students will differ in their rate of acquisition of appropriate knowledge and skills, so that by the end of their five years of study they will differ in their ability to practice medicine competently. A small number, perhaps 5-10% or so [55], will have insufficient knowledge and skills to pass their exams and will leave the school; the majority however will qualify. Figure 4 models the rate of growth of knowledge in individual students, two of whom fail at various stages of their course.

Education encourages students to acquire more *appropriate* knowledge i.e. knowledge which is useful and applicable. We will assume that students who acquire appropriate knowledge are less likely, on aggregate, to perform poorly. The process can be modelled by assuming that, as in figure 3, that individuals two standard deviations above and below the mean level of knowledge differ in their likelihood of poor performance by a factor of three. The effect of training (figure 5b) is to increase the amount of knowledge and thereby to shift the distribution of poor-performance proneness to the right, thereby making poor performance less likely. If the shift to the right is by the fairly small amount of half a standard deviation (i.e. an individual on the 5th percentile acquires the knowledge of an individual on the 13th percentile) then the rate of poor performance overall decreases to 75% of its previous level; and if the shift is by one standard deviation, in which the individual on the 5th percentile achieves the knowledge level of an individual on the 26th percentile) then the rate of poor performance falls to 57% of its previous level.

Training even at relatively modest levels can therefore have effects upon performance which can only be achieved through selection by concentrating selection upon a single criterion. In parentheses it should be noted here that the argument is formally identical to that made by Rose [56] in epidemiology for shifting the population distribution of risk factors, rather than concentrating on identifying a few high risk individuals. In the present context, the key point is that training affects all students whereas selection, necessarily, affects only a few. Training also has other advantages: it can be focused on the specific problem areas where poor performance occurs - so that skills, knowledge and attitudes can be provided which directly

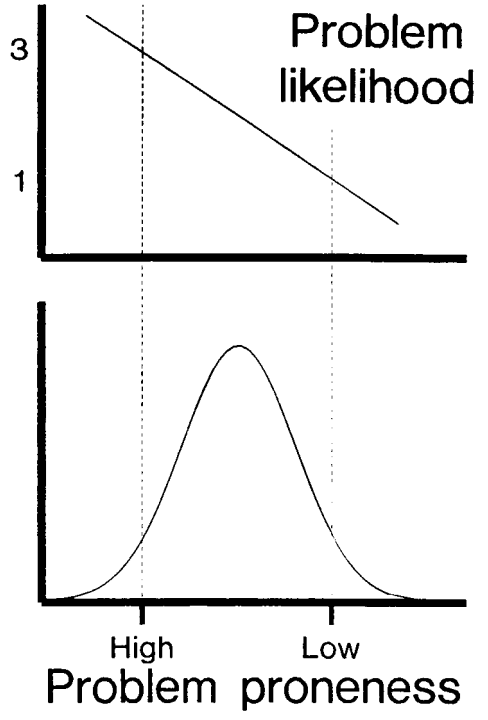

Figure 3. The x-axis in (b) shows the distribution of proneness of individuals to show a particular performance problem, and (a) shows the likelihood of a performance related problem arising, set to that individuals on the 5th percentile are three times more likely to have a problem than those on the 95th percentile.

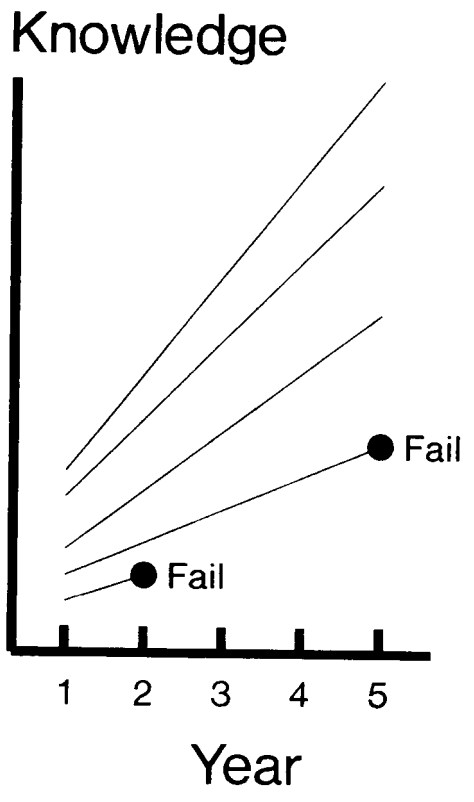

Figure 4. A model of the growth of medical knowledge during medical school. Two individuals acquire insufficient knowledge to pass the examinations. Amongst those who do pass there is still substantial variation.

improve performance. However selection and training may interact; we may be able to powerfully influence training *by selecting those doctors who are willing to learn and to practice in ways that best improves their overall performance.*

Selection for Training

Motivation, learning experience and study skills will all affect the efficiency and effectiveness of training, and to a large extent these attributes will be independent of simple intellectual ability. If this is taken into account the effects of selection are two-fold. Firstly, by selecting entrants who are in the upper part of the distribution for learning ability, the overall knowledge and ability of the students is increased. Secondly, the variability between students will be reduced, thereby helping to promote a 'culture' or 'ethos' in which independent, self-motivated learning is the

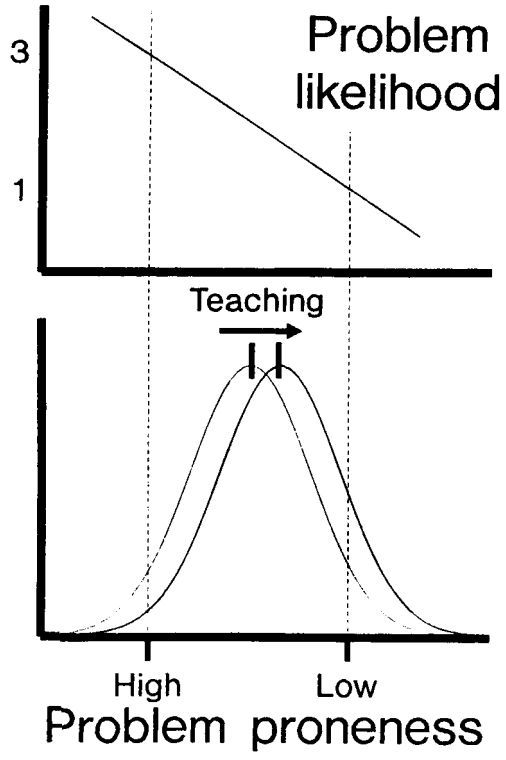

Figure 5. A similar figure to figure 3 except that training has shifted the distribution of proneness to poor performance to the right, thereby substantially reducing the overall likelihood of poor performance.

norm, so that new knowledge and hence improved performance continues to be acquired throughout post-graduate training. Selection for ability to be trained therefore has a 'multiplier effect', over and above that of simple personality differences, and makes it a particularly powerful form of selection.

16.9. What are the *Canonical Characteristics* to be Found by Selection?

We have argued that selection for specific, performance-related personality characteristics is unlikely to be an effective way of reducing poor performance, and may indeed be counter-productive; training is probably much more effective. If selection does have a role then it is likely to be principally in terms of selecting for 'ability to be trained'. If that is the case then what are the *canonical characteristics* on which selection should be based? Here we are searching for a small number of broadly uncorrelated characteristics, that can actually be measured, and which predict independent aspects of the ability to be trained at medical school, and to perform as a medical student and doctor.

At present the most important criterion used during student selection is academic ability (as measured by GCSE and A-level results in the UK), which probably reflects both intellectual ability and motivation. Medical students have to learn prodigious quantities of information and must study for frequent exams, so that previous ability to study and pass exams is likely to be a useful predictor of success. Achievement at academic examinations is also correlated with general intellectual ability and, and there seems little doubt that IQ does reflect the ability to respond to diverse problems and challenges [57].

Of course that is not to say that academic ability and intelligence should be the only criteria of selection. Although A-level results do correlate with success in university-level training, the correlation is not high, either in general [58-60], or specifically in medicine [61-65]. Studies of achievement in university students in general suggests that *approaches to study* are also important predictors of success, and are independent of previous achievement [66-70]. In particular 'deep learning' seems to be a good correlate of achievement in academic disciplines, and 'strategic learning' of achievement in applied professions. 'Surface learning' in all subjects seems to be predictive of failure, and it is an approach which often seems to be encouraged by the type of curriculum found in medical schools [71,72]. Learning strategies are therefore good candidates as selection criteria, particularly since we have recently presented evidence that deep and strategic learning styles at selection are predictive of the amount of clinical experience (but not of examination results) five to six years later [48,73]. Biographical information, in particular extensive achievement in music, sport or other hobbies, indicates self-motivation and an ability to direct one's study which probably correlates with strategic learning. Similarly participation in community activities, particularly those involved with medical or para-medical activities, probably also indicates an ability to assign priorities and be self motivated.

A third candidate for a canonical selection characteristics is communication ability. Most areas of medicine require an ability to relate to patients and to empathise with them, and many medical much poor performance results not so much from technical failure but from failures of doctor-patient or inter-professional communication. If students are to be trained in communication skills (and there seems little doubt that they benefit from such training [74,75]), then it makes sense to concentrate training on those who already show a certain minimum level of ability and willingness to learn. Whether medical school interviews can realistically assess communicative ability using present methods is still not clear; it is certainly an objective of interviews, and more likely to be successful when 'ability to communicate' forms an explicit part of the ratings made for each interviewee by each interviewer. However there seems little doubt that this area should be given more attention, particularly as much poor performance stems from deficiencies in this area. A-level results reflect the results of years of study. In contrast communication ability is typically assessed directly in a highly artificial fifteen minute interview, and indirectly, and probably unreliably, through references and candidate statements.

16.10. Medical Training

Just as one can define canonical characteristics for potential doctors, so one can define canonical skills and attitudes that should be learnt and encouraged during training. Clearly a certain number of operations need to be seen, skills practised and patients clerked (although there is much variation in this [76]). Can we discern any underlying themes of training that might make for higher performance medicine? Medical training is a vast area which we can hardly begin to consider here in its full richness. Defining clinical competence and the skills that underlie it is a complex and difficult task [77,78]. Here we will consider just a few aspects of training which are often neglected, and which we believe may be especially relevant to discouraging poor performance:

Decision Making

Doctors continually make decisions about patients, concerning diagnosis, aetiology, treatment and management. It is surprising therefore how little effort has been put into *teaching* the process of decision making. Few medical schools have formal courses on diagnosis, or attempt to examine the process itself beyond mere exhortations to 'think', or the setting of example merely by apprenticeship. And likewise few doctors, at any level of specialisation, are conversant with formal aids to decision-making in medicine [79-81], despite the existence of computer software for aiding and making explicit the process. If faulty decision-making is a key process in poor performance (and the Dutch data quoted above would suggest it is) then the teaching of medical decision making should be an important part of the medical curriculum [82,83].

Communication and Inter-personal Skills

Training in communication skills is at last being accepted in British medical schools as a central part of the curriculum [74,84], even though until recently only a small amount of time has been allotted to it [85,86]. Such training as there is concerns itself almost entirely with doctor-patient communication and tends to concentrate on basic interviewing skills, with some additional sessions on specific topics such as breaking bad news. The data presented in table 1 on the nature of poor performance suggests that this kind of training needs to be expanded to include working in teams, inter-professional communication, coping with personality and mental health problems of fellow professionals, and the capacity to reflect on one's own behaviour and performance. It is also self-evident that if such training is important then it must also be assessed in undergraduate and postgraduate examinations, particularly since there is clear evidence for the reliability of methods of assessment [87-89].

Auditing One's Own and Others' Performance

It is rare for medical curricula to contain explicit teaching on the methods by which high quality clinical performance is maintained - on the need for regular audit, self-criticism, and continuing professional development. The result is that examinations rarely ask about clinical performance *per se*, or about how to maximise it, how patients respond to poor performance, and about how doctors should handle situations in which poor performance occurs, either due to their own actions or the actions of others. Now that medical schools are beginning to design *core curricula*, with specific educational objectives it would seem reasonable to include such aspects within the objectives of medical courses. And then of course they would also require assessment.

The Setting of Objectives for Training

Much emphasis in medical training is put upon the need for students to acquire a wide-range of experience of different conditions. However this experience is seldom actually assessed, with the result that by the end of their studies, medical students vary immensely in the experience they have gained of medical conditions and of practical procedures [76,90,91]. If experience is important then it should be possible to systematise the nature of the experience that particularly matters. The use of 'log-books' or 'checklists' [92] can ensure that a sufficiently broad range and depth of experience is obtained, thereby setting minimum standards for all students. If combined with a curriculum that sets out specific learning objectives from such experiences, coupled with educational support in the form of tutorials and seminars, then experience will be far broader than that attained in the uncontrolled and unsystematic chance way that is typical of most medical schools.

The Setting of Objectives in Examinations

If training is to emphasise the acquisition of basic skills, as well as academic knowledge, then examinations must reflect this change of emphasis. Conventional final medical examinations have many problems [93]: they are often poorly organised, haphazard in their assessment of knowledge, ignore attitudes and skills, and typically do not observe the details of processes such as history-taking, examination and diagnostic testing. The result is that students feel that processes are unimportant, and that the sole objective of learning is to be able to answer an examiner's questions, rather than to become self-critically competent. The development of OSCEs (Objective Structured Clinical Examinations), particularly if in the context of *Skills Labs* [94] has helped students to concentrate on the structure of clinical tasks, ensuring that important details, which are often the first to slip in a poorly performing doctor, are not overlooked [95-97]. A more wide-spread use of such assessment methods is likely to decrease poor performance by doctors.

16.11. Conclusions

Although superficially attractive as an idea, the effects of selecting to reduce future poor performance are likely to be small and there would probably be other indirect effects on other criteria (such as academic ability) which could *increase* the incidence of poor performance. If selection is to influence performance then it will only do so indirectly, through increasing the overall competence of doctors. The potential effects of education and training upon performance are potentially far greater than those of selection, and therefore the optimal form of selection should concentrate upon a small number of well-specified criteria which are likely directly to affect overall competency.

Three principal areas on which medical student selection might concentrate seem to be:

i. Academic achievement as expressed in conventional public examination results.
ii. Study habits, and in particular a 'strategic' or 'deep' approach to learning.
iii. Ability to communicate, perhaps assessed in part by interviews, but probably capable of more formal, systematic assessment.

Although we have argued that multiple criteria for selection are ultimately unproductive, there is undoubtedly an argument for shifting the balance between the three canonical criteria we have proposed. At present academic achievement far outweighs the others in importance, and that necessarily restricts the possibility of selecting on the other criteria [48], and we believe it is clear that greater weight should be given to communication and personal factors and learning style in the interests of training a more rounded and better performing doctor. Training for improved performance could be enhanced by: (i) training in decision-making; (ii) training in communication and inter-personal skills; (iii) the setting of specific training objectives; (iv) a greater emphasis on assessing basic skills; and, (v) specific formal training in performance related matters, such as the causes of problems and adverse outcomes within each specialty.

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Problem Doctors

A Conspiracy of Silence

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