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## ANALYSES/REVIEWS OF THE LITERATURE

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### **Selection of Medical Students: Philosophic, Political, Social, and Educational Bases**

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*The task of selecting a cohort of medical students from a pool of well-qualified applicants is complex and fraught with ethical dilemmas and organizational difficulties. In this article, we identify and attempt to formalize the constraints on the task. In response to a range of pressures (or influences) a medical school creates a selection policy, in which selectors define the "necessary characteristics" of medical school entrants, such as their personal qualities, aptitudes, demography, and so forth. Implementation of that selection policy then involves choosing a range of selection processes or techniques which can be used to find those candidates within the pool of applicants who satisfy a range of "selectable characteristics." Evaluation of the success of the selection policy involves comparison of the selectable characteristics with the necessary characteristics; this essential step can be used iteratively to achieve eventual congruence between selection policy and selection process.*

*Also in this article, we give specific examples of the pressures that school may be subject to, the characteristics that are selectable, and the processes that may be used, and we consider the implications of various selection processes for those selection policies.*

Medical student selection is an important and complex process. Doctors play an important role in society, and their selection interests many groups of people for a variety of reasons. Careful and serious consideration of the process by selection committees would be helped by a formal

model that explicitly states principles, assumptions, and constraints. Because such a model enables identification of all relevant issues, its use should result in better decisions which more closely reflect the implicit and explicit requirements of those setting admissions policy.

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### The Need for Selection

There are at least three imperatives for adopting a selection process for entry to medical school. First, there is usually a need to reduce numbers because courses are typically oversubscribed. Second, however, an admissions barrier is necessary even when courses are undersubscribed, because some applicants are unsuitable for training: Selection must exclude those whom *The Lancet*<sup>1</sup> called the "conspicuously inadequate." Third, after unsuitable candidates have been excluded, a selection process is required to identify candidates with desirable qualities, such as superior academic credentials or personal attributes. Reduction in numbers, exclusion of unsuitable candidates, and selection for desirable qualities are logically separate processes.

All medical schools have a selection system for future doctors, be it explicit (and actively controlling entry) or implicit (and acting through self-selection and/or attrition through examination failure). In this article, we provide a conceptual map of the objectives of, and the methods for, medical student selection. Limited space does not allow us to address the more complex questions concerning the legal, moral, ethical, and educational aspects of particular methods, or their professional desirability.

Our approach is similar to that adopted in other studies of conceptually complex areas, in which different theories are compared over a range of outcomes, but without evaluation of those theories—as, for example, Stevenson,<sup>2</sup> who compared different metaphysical theories of existence, and Siegler and Osmond,<sup>3</sup> who systematically compared models of psychiatric care.

### The Logical Structure of This Analysis

Different groups in society apply pressures to ensure that certain types of applicant are chosen as students in medical schools. In response, medical schools develop a selection policy that accommodates such pressures if they are compatible with its own goals. The selection policy is instantiated in a selection strategy incorporating processes for gathering information and making decisions.

Our analysis first considers the personal characteristics that may be sought in candidates and then describes the pressures applied by societal groups to ensure candidates with those characteristics are admitted. We then consider possible processes for gathering information about candidates. Finally

we consider the implications of particular policies and the potential efficiency and effectiveness of the selection strategies.

### A Formal Mathematical Model Underlying Selection

We consider that all practical selection processes can be conceptualized as a simple linear model analogous to multiple linear regression. There are several characteristics that can be quantitatively assessed in each candidate,  $c_1$ ,  $c_2$ ,  $c_3$ , and so forth, and these can be combined after weighting by factors,  $w_1$ ,  $w_2$ ,  $w_3$ , and so forth to produce a score,  $S$ . Additionally there will be a random component,  $r$ , which arises either from inaccuracies in measurement or is added deliberately, as occurs in selection methods based on a lottery. For each candidate the score  $S$  is given by:

$$S = w_1c_1 + w_2c_2 + w_3c_3 + \dots + r. \quad (1)$$

If  $S$  is above a particular threshold, then the candidate is selected; otherwise, he or she is rejected. The model allows for different weighting of components such as academic marks, demographic variables, and other assessments, and by manipulation of the various weights allows a range of subtle variations during selection. To give a concrete example in a British context, selection may use a formula which says:

$$S = 0.5 \times \text{A-Level Points} + 0.2 \times \text{Interviewers' Assessment} + 0.1 \text{ (if candidate is educationally disadvantaged)}. \quad (2)$$

It is clear that broad changes in a selection policy can be achieved by inclusion or exclusion of particular characteristics, whereas fine-tuning of policy is achieved by altering the weights.

Although the model may seem complex and unrelated to actual practice, we argue that this is not the case. The apparent complexity is simply that the model is not usually expressly articulated in this form (but see, e.g., McManus & Richards;<sup>4,5</sup> McManus et al.<sup>6</sup>).

### Characteristics of Possible Importance in Medical Student Selection

In this section, the personal characteristics of possible interest to admissions committees are briefly described. The list is not exhaustive and some terms are shorthand for several related characteristics.

1. *Academic achievement (A)*. Demonstrated ability in public examinations, particularly the learning, recall, and utilization of factual information. This is related to intelligence in its narrower definitions.

2. *Intellectual and reasoning skills (I)*. An individual's style of manipulating concepts and information, and of approaching study and learning, including terms such as creativity, surface and deep processing, problem solving, and logical reasoning. It is broadly orthogonal to academic achievement.

3. *Personality (P)*. The enduring characteristics of individuals such as adaptability, maturity, extraversion, perseverance, initiative, and intrinsic motivations. Much "biadata" (Herriot<sup>7</sup>), assessed as "interests" and "hobbies," can be viewed as indirect indicators of personality; playing a musical instrument is an indicator of commitment, perseverance, and drive, *inter alia*.

4. *Demographic characteristics (D)*. Typically fixed sociological indices such as age, sex, ethnic origin, domicile, type of school attended.

5. *Interpersonal and communication skills (IC)*. The ability to communicate with others, using writing and speech, and to appreciate others' cognitive and emotional needs, providing empathy and support and controlling interactions effectively.

6. *Health and handicap (H)*. Specific disabilities—such as deafness, blindness, or lack of motor control—or chronic problems of physical health that may compromise performance and competence in a student or medical practitioner.

7. *Psychomotor skills (PM)*. The ability to make sensory judgments, perform motor tasks, and integrate sensory and motor processes, as required for complex technical procedures.

8. *Attitudes (AT)*. The values, beliefs, and opinions concerning the gamut of social, moral, ethical, and political issues important to the practice of medicine.

9. *Motivation to study medicine and become a doctor (M)*. The reasons given by potential medical students for studying medicine, including the influence of parents or teachers, as well as knowledge of the nature of medicine as a course and career.

### Pressures Influencing Selection

The different responsibilities and perceived needs of various groups and individuals influence their perception of who should be selected for medical training. Each group exerts a pressure on the selection committee to ensure that their requirements are met. Possible objectives of some

major groups are briefly outlined here, together with the personal characteristics required of students to meet such objectives. The relationship between the pressures and the required personal characteristics is summarized in Table 1.

### Pressures Within the University and Medical School

Universities are concerned principally with education, and therefore try to select students who will respond well to teaching and pass examinations. Universities also wish to produce graduates who will enhance the reputation of the institution. They may also consider the broader student community, searching for students who will make the institution a dynamic, happy working environment, perhaps by participating in extracurricular activities and gaining what William Osler called an avocation alongside their vocation of medicine. The personal characteristics of applicants that would favor achieving these objectives are (grouped by objective):

1. *Examination achievement*. Future successful examination achievement is probably best predicted by previous successful performance in academic examinations (A), especially if similar in type to those at university (Gough<sup>8</sup>). Of additional importance are a candidate's intellectual and reasoning skills (I), their approach to study, and their motivation (M) to study medicine.

2. *Long-term academic successes*. A university's reputation depends on its graduates and whether they become Nobel laureates, Fellows of the Royal Society, holders of university chairs, Fellows of Royal Colleges or other professional bodies, and holders of postgraduate degrees and professional qualifications. Accordingly, medical schools may select candidates with a proven examination record (A), and with appropriate reasoning skills (I) for subsequent self-directed learning, coupled with inner motivations (M, P) which favor further academic success.

3. *Professional competence*. Medical schools require students to be competent professionally in communicating with patients, families, and staff, in taking histories and performing clinical procedures. Universities are similarly concerned with these issues because staff of other hospitals will evaluate the university through the skills of its students. Interpersonal skills (IC) are important here for doctor-patient communication; intellectual and reasoning skills (I) are important in a student's professional approach to medical practice. Perhaps of lesser importance are personality

**Table 1. Policy-Making Matrix**

Pressures on Policymakers	Candidate Characteristic <sup>a</sup>								
	A	I	P	D	IC	H	PM	AT	M
<b>University Pressures</b>									
Examination Achievement	*	o							o
Long-Term Academic Success	*	*	*						*
Professional Competence		*	o		*		o	o	
Specific Curriculum	o	*	o		o			o	o
Medical School Community			*	o	o			*	
<b>Professional Pressures</b>									
Legal/Registration/Certification						*		o	
Maintaining Standards		*	*		o		o	o	*
Selection for a Specialty			o	o	*		*	o	
<b>Community Pressures</b>									
"Good" Doctors			*		*		o	*	*
Optimal Matching of Characteristics to Specialties				*				*	
<b>Political Pressures</b>									
Affirmative Action/Discrimination/Bias	o			*		*			
Fee-Paying Overseas Students				*					
Doctors for a Health-Care System			o	*				*	
Resource Efficiency	o	o	o				o	o	o

Note: Asterisk denotes a major relationship between the pressure and the candidate characteristic; open circle denotes a minor relationship.

<sup>a</sup>See text for explanation of abbreviations.

(P), attitudes (AT) and inherent psychomotor ability, or aptitude (PM; see also Murden et al.<sup>9</sup>).

4. *The nature of the curriculum.* The educational methods of problem-oriented courses differ from traditional curricula. Therefore, particular approaches to learning (I) and good interpersonal skills (IC), along with particular personality types (such as independence and creativity, P) and attitudes (AT), may enhance the student's response to such teaching.

5. *Contribution to the broader medical school community.* Medical schools differ widely in their institutional "personalities." The group dynamics of a complex community are affected by many things, including the personality (P) and attitudes (AT) of its members, their interpersonal skills (IC), and demographic factors (D) such as sex ratio or age range.

**Professional Pressures**

Professions can be seen either as groups of individuals gathered together to advance their subject, and to ensure a continuing and increasing standard of practice, or, more cynically, as a Machiavellian conspiracy against the rest of society to further the personal ends of the members of the profession. Considering only the former, then professional bodies may influence selection from three perspectives:

1. *Issues of registration and legal certification.* Bodies such as the General Medical Council in the United Kingdom, the Australian Medical Council and the State Medical Boards in Australia, and the Medical Council in Canada are legally responsible for ensuring that doctors on the register are competent to practice. In general this has little to do with selection because the criteria concern minimal standards, affect only a few individuals, and apply after final examinations. Exceptions are worth considering for illustration. A medical graduate with a physical handicap (H), such as deafness or blindness, may not be capable of carrying out some items of history taking or physical examination, so that subsequently registration bodies may not be able to register such individuals. Similarly, a graduate may have extreme attitudes (AT) preventing him or her from giving treatments considered to be normal in a doctor's repertoire — perhaps a vegan\* unwilling to prescribe animal products such as insulin.

2. *The maintenance and improvement of professional standards.* A challenge for medical education is ensuring that graduates "continue to keep abreast of the expanding knowledge base and the technology of medicine" (Ebert & Ginsberg,<sup>10</sup> p. 7); thus professional bodies encourage continuing education throughout medical careers.

\*An individual who chooses a diet containing no animal-derived matter whatsoever.

They might therefore recommend the selection of students with particular approaches to study and learning (I), motivation (M) for independent study, personality (P) reflecting intrinsic drive, and appropriate attitudes (AT). Specialist expertise may also depend on psychomotor skills (PM), as in surgery, or interpersonal skills (IC) as in general practice or psychiatry.

3. *Selection for career speciality.* Different specialties require different skills and attributes, and if these skills are less amenable to training, such as psychomotor (PM) or interpersonal skills (IC), then specialties may recommend their emphasis at selection (Gough & Bell<sup>11</sup>). Additionally, attitudes (AT), personality (P), or demography (D) may influence career choice, as in applicants from rural areas who may subsequently practice in such areas, or mature entrants or women who are less likely to specialize in surgery (Allen<sup>12</sup>).

### Community Pressures

The community at large, interpreted broadly as patients and potential recipients of medical care, has opinions about who should practice as a doctor, and hence who should be selected for professional training.

1. *Selection of "good doctors."* The community prefers that its doctors are "good doctors." A definition is not easy but the public generally sees technical performance as less important and best left to professional bodies to oversee (see, e.g., Linke et al.<sup>13</sup>). Instead, the public wants doctors who communicate well (IC), give appropriate emotional support, are empathic, and have appropriate personality (P) and attitudes (AT). The community also prefers doctors to have high intrinsic motivation (M), with a vocation in the old-fashioned sense. Because patients also prefer doctors to be competent at simple but uncomfortable procedures such as phlebotomy, cervical smears and proctoscopy, psychomotor ability (PM) may be important.

2. *Matching doctors to specialties, posts, and communities.* The community recognizes that different medical specialties may be best served by different types of doctor; thus demographic factors (D) such as sex may be important because many women might prefer female obstetricians, gynecologists, and general practitioners. Likewise, ethnic minorities may prefer doctors from their own community. Whether when students qualify they will then practice in the desired areas might depend on certain attitudes (AT).

### Political Pressures

Universities are subjected to external pressures on their activities from political and legal sources, particularly when training professionals to work in large, expensive organizations, such as health services.

1. *Discrimination, bias, and affirmative action.* In the United Kingdom, legislation such as the Race Relations Act (1976) and the Sex Discrimination Act (1975) prohibit discrimination or affirmative action on the basis of race or sex. Equality of opportunity means that academic achievement (A) will be the predominant selection criterion. The law requires that certain demographic information (D) *not* be used by the admissions committee. In other countries, legislation encourages quotas for individuals from particular minorities, making demographic information (D) important. Alternatively, political policy may encourage the selection of handicapped applicants (H).

2. *Payment for medical training.* Medical training is expensive, and often in scarce supply. It might be attractive for universities to train foreign nationals for a fee to allow them to subsidize other educational activities. For selection of such medical students, specific demographic (D) data are required.

3. *The nature of the health-care system.* The nature of the health-care system influences the type of person selected for medical school, those who manage the health-care system having a particular notion of the kind of student best suited to the system, so that a spectrum of desirable attitudes (AT) and personalities (P) may be defined. Health-care systems centering on "barefoot doctors" or "village health workers" for rural areas may emphasize demographic information (D), students perhaps being selected from specific sectors of society or geographical areas. Alternatively, some health-care systems may select students with particular attitudes (AT), as in socialist countries where party membership is required of students.

4. *Resource efficiency.* Health education and health maintenance are expensive. Efficient production of graduates in terms of higher examination success rates at medical school puts a higher priority on academic achievement (A). Alternatively, economic pressure from the health-care system to improve the standards of medical care, and hence reduce costs, may put pressure on selection for particular attitudes (AT), personality (P), intellectual skills (I), and psychomotor skills (PM). Of course, all such potential savings require a formal economic assessment of their marginal

costs and benefits. Thus although extra costs may be incurred from educating and employing hand-icapped students (H), these may be offset by the hidden value, expressed as altruism, accruing to society, and from the educational benefits for the medical school of having handicapped individuals in its classes.

**Moral Pressures: Fairness, Justice, Equity, and Social Responsibility**

Selection decisions necessarily have a moral component, which is logically separate from the other pressures mentioned insofar as the moral pressures arise from within the selectors themselves, from the superego or conscience. Although, at first sight, the moral pressures appear to be equivalent to other pressures on selectors, in fact they operate at a different level altogether. The matrix in Table 1 shows the sort of characteristics that must be assessed in applicants if selectors are to respond to certain outside pressures. However, there are no characteristics in the applicants that will tell us if we are acting morally, justly, or equitably. It is entirely the conscience of the selector that tells if a selection practice is immoral or amoral.

There are two issues of moral concern that need to be discussed in the present context:

1. *Fairness.* If a selection practice does not agree with the stated selection policy, then the system is unfair. Modern notions of justice and fairness are strongly influenced by Rawls,<sup>14</sup> who argued that a system is fair to individuals if, when comparing two groups, individuals randomly re-born into either group are equally happy with the outcome.

2. *Equity and social responsibility.* Equity and social responsibility at a societal level are

separate from fairness at the individual level, as exemplified by the Bakke case in the United States. A selection policy may thus be unfair to an individual but fair socially to a minority group that previously had been discriminated against.

**The Potential of Selection Processes for Identifying the Personal Characteristics of Applicants**

Selection processes elicit information about applicants either directly or indirectly. Direct measurements require the candidate to demonstrate the characteristic, whereas indirect assessments involve inference based on either the perceptions of an outside observer or other indicators of a characteristic. Thus perseverance in the face of frustration may be measured directly in an assessment center where candidates are given difficult and complicated tasks or can be inferred indirectly from biodata concerning hobbies and interests. For example, playing the piano to a high standard would indicate the candidate has endured extended practice.

Table 2 summarizes the processes (to be described) by which the personal characteristics of applicants can be assessed.

1. *Self-selection.* By applying to medical school, candidates make a statement about their own perception of their suitability for a medical career in terms of personality (P), interpersonal skills (IC), health (H), and attitudes (AT). Such information is indirect, however, and possibly invalid. Three types of direct information can be gleaned from an application form: (a) demographic data (D), (b) academic ability (A), and (c) motivation (M). However, motivations may not be those which the selectors consider desirable (e.g.,

**Table 2. Selection Strategy Matrix**

Selection Strategy	Candidate Characteristic <sup>a</sup>								
	A	I	P	D	IC	H	PM	AT	M
Self-Selection	*		o	*	o	o		o	*
Autobiographical/Self-Description			o		*	*		*	*
References/Testimonials		*	o		o	o	o	o	o
Academic Record	*	o			o				
Demography				*					
Psychomotor/Psychometric Testing		*	o		o	*	*	*	*
Interview	o	o	*	*	*	o		*	*
Job Simulation Exercises (Individual)		*	o		*	o	*	o	
Group Exercises		o	*		*	o		*	

Note: Asterisk indicates characteristic can be assessed directly from the selection process; open circle indicates indirect assessment.  
<sup>a</sup>See text for explanation of abbreviations.

parental aspirations or expectation of high financial rewards on graduation).

2. *Autobiographical and other self-descriptive information.* Autobiographical accounts provide direct information about communication skills (IC; particularly written communication), about handicaps (H; with descriptions of capabilities and limitations), and about attitudes (AT) and motivations (M). Assessment of attitudes (AT) is direct because attitudes are defined precisely as "descriptions of possible behaviors," although of course the description could be false, being stated that way to create a favorable impression. Personality (P) is defined in terms of the actual behavior of individuals so that written self-descriptions are at best indirect indicators of behavior in subsequent situations.

3. *References and testimonials.* References from a head teacher or school principal can give direct information about intellectual and reasoning skills (I), as the candidate has been observed in the classroom. References can also give objective information about motivation (M), health and handicap (H), communication skills (IC), and attitudes (AT). Testimonials can provide other information, much of it indirect, concerning motivation (M), personality (P), and psychomotor skills (PM).

4. *Record of academic achievement.* The candidate's achievement in public examinations provides direct evidence of academic ability (A) and, from the spectrum of subjects, an indirect indication of intellectual and reasoning skills (I) and communication skills (IC).

5. *Demography.* Information about a candidate's age, sex, or ethnic origin can be obtained directly, providing these, and similar questions can legally be asked of the candidate at the time of application.

6. *Psychomotor and psychometric testing.* Psychomotor tasks provide direct information about sensory or motor deficits (H) and about specific skills such as manual dexterity (PM). Formal psychological testing gives direct information about problem-solving ability (I) and about attitudes (AT) and motivations (M). Additionally, such tests can provide indirect information about personality (P) and, if written or verbal expression is required, about communication skills (IC). Aspects of communication skills (IC) can also be assessed by tests such as the Profile of Nonverbal Sensitivity (Rosenthal et al.<sup>15</sup>) or measures of empathy (Krupka<sup>16</sup>).

7. *Interviews.* Interviewers attempt to assess many characteristics during an interview. Many of these—such as academic ability (A), styles of reasoning (I), and health (H)—can only be as-

essed indirectly (and not always reliably; e.g., Richards et al.<sup>17</sup>). Attitudes (AT) and motivation (M), however, can be assessed directly by specific questions. Personality (P) is assessed directly, because the candidate is performing the behaviors of interest. Likewise, communication skills (IC) and demographic information (D) can be assessed directly.

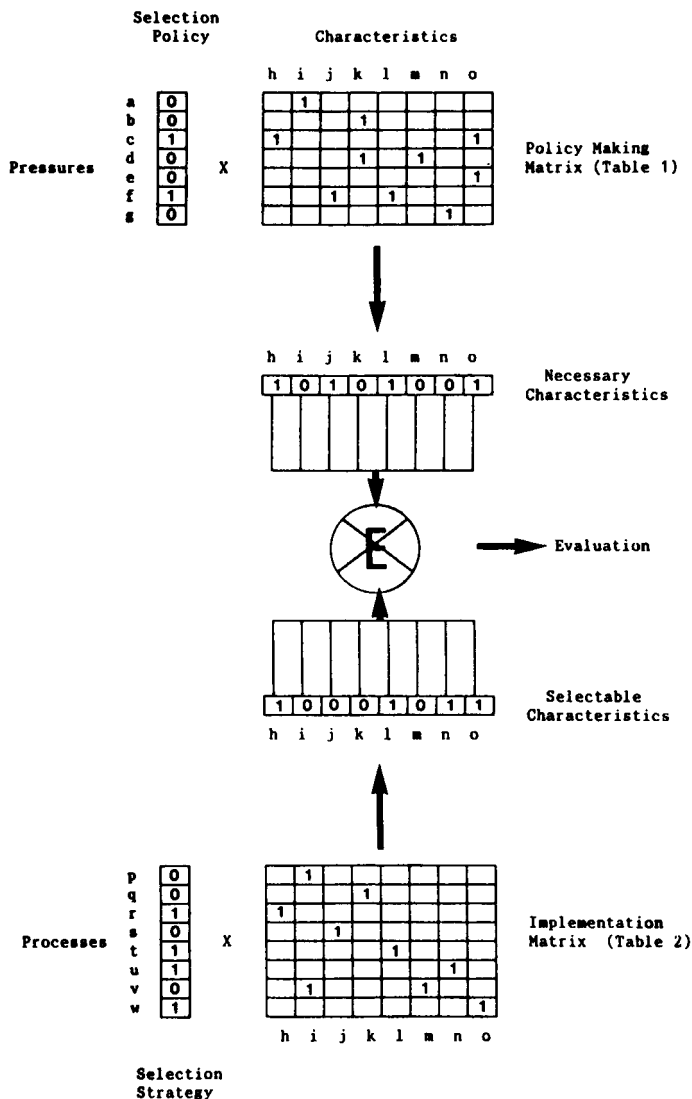
8. *Job simulation exercises.* These are not common components of medical school selection processes, but are frequently used for selection of civil servants or army officials. Individuals usually attend a specific assessment center where they perform individual tasks containing skills specific for the job for which they have applied. If the exercises are correctly designed, a direct assessment can be made of specific reasoning skills (I), psychomotor skills (PM), and specific communication skills such as writing or, by using videotapes or actors, interpersonal skills (IC). Inferences about personality (P) and health and handicap (H) can be made.

9. *Group exercises.* Once again these are rarely used in medical student selection, but in tasks involving perhaps half-a-dozen individuals in a group decision-making exercise, they allow direct observation of personality characteristics (P, such as forthrightness or extraversion) and attitudes (AT), as well as interpersonal skills (IC) such as verbal communication, management of discussion, and control of emotion.

### Selection Policies

As indicated in Table 1, there are many pressures on medical schools to select students in particular ways. Responding to such pressures each school develops a selection policy, deciding, for each of the pressures to which it is subject, which ones to ignore and which to take into account. A selection policy can be formally represented as in Figure 1 by a column vector, which expresses the content of the Pressure  $\times$  Characteristic matrix (Table 1) to give a row vector indicating those characteristics to be assessed during selection. The row vector therefore indicates the necessary characteristics on which candidates should be assessed in order that the pressures can be satisfied (Figure 1).

The selection policy of a school is realized in its selection strategy, in which a range of processes are used to assess the characteristics that will be used in selection (Table 2). A selection strategy can, like a selection policy, be represented as a column vector and it can be applied to the matrix of Table 2, to obtain a second row vector, the selectable characteristics vector (Figure 1), which



**Figure 1.** Diagrammatic representation of the interrelationships between the terms described in the text. The selection policy, in response to pressures (labeled a to g), defines the necessary characteristics (labeled h to o), which are to be sought in candidates (see Table 1). A 1 indicates that the characteristic is sought; a 0 indicates that the characteristic is not sought. The combination of selection processes (labeled p to w), which constitute the selection strategy, are used to identify candidates with these characteristics (see Table 2). Ideally, the selectable characteristics and the necessary characteristics will be the same. An evaluation process, E, can be used to show whether this is the case; in our example it is not.

indicates the characteristics for which information can be obtained by using a particular strategy.

The two row vectors, of necessary characteristics and selectable characteristics, can be compared to evaluate the selection strategy. If they match, then the selection strategy is capable of implementing the selection policy—assuming that it is properly administered. A mismatch can result from two possible situations: (a) If a characteristic is necessary but not selectable, then the strategy will not satisfy the policy and additional information must be collected; or (b) if a characteristic is

selectable but not necessary, then although the selection policy is satisfactory, there is the potential problem that the additional information, which is not needed to carry out policy, may actually be used by selectors, perhaps resulting in the inadvertent implementation of a covert policy, and, perhaps, an unintended discrimination against certain candidates. An ideal selection system makes available to selectors only that information necessary to satisfy its policy and no more; to do otherwise overloads selectors with unnecessary information and makes policy deviations more likely.



### Why Is There a Problem of Selection?

Expressing the selection process in the form we have described indicates clearly that the fundamental problem of selection arises from the nature of the policy-making matrix (Table 1). Except in a few mathematically degenerate cases, this matrix is multidimensional, with the practical consequence that it is rarely possible simultaneously to satisfy all the pressures to which medical schools are subject. A partial solution is achieved by assigning a value to each pressure on a uniform, comparable scale, as economists do in marginal analyses of multidimensional economic systems. The multidimensionality is therefore reduced to pseudounidimensionality, and an optimum result is once more achievable on the single (new) scale of "educational value," "cost of producing each graduate," "community benefit," or whatever. Such a rationalization, however, highlights the philosophical dilemma of equating unequal pressures on a single scale: What is the value of a good medical school community on a scale of examination achievement, for instance? It is clear from this example that a formal solution cannot be achieved by a clerical reduction to a unidimensional system; instead, selection committees will have to accept that they must clearly articulate the various options and then make difficult decisions.

### Specific Selection Policies and Strategies

As an example of the use of the formal method for analyzing selection, and its implications, we consider several common selection policies and strategies. For illustration we have considered fairly extreme cases to make their implications obvious.

1. *"No selection."* At its most extreme, the method considers all applicants equal, and randomly chooses among them. With no selectable characteristics, the implication is that the selection policy ignores all pressures, because this is the only way that no desirable characteristics appear in the matrix. If, however, any selection pressures are accepted as valid, then inevitably the search for the necessary characteristics implied by the pressures cannot be satisfied by such a selection process.

2. *Self-selection.* In this method, there are more applicants than places, and selection takes place by creating some hurdle, such as willingness to wait for a length of time before admission or possessing a certain amount of work experience in

health care. The hurdles are set to ensure that eventually the number of qualified applicants matches the number of places available. Self-selection systems are often advocated because they seem neutral and passive from the selectors' point of view—the selectors can simply observe those individuals who actually jump over the hurdle; indeed, the necessary-characteristics vector is zero. Satisfactory evaluation clearly requires that the selectable-characteristics vector is also zero. However, self-selection is manifested in the selection-strategy vector, and accordingly the selectable-characteristics vector cannot be zero. Not to select is, in practice, always to select but to lose control over the process. To take an extreme example, if self-selection were defined as the willingness to work unpaid in a hospital for 10 years before medical school entry, then it is a fair prediction that only the children of the very rich would enter medical school.

3. *"Minimalist" selection.* This is a popular approach to selection. Proponents would argue that the only criterion for admission that is generally accepted by both the public and educators is the academic record: The better qualified applicant in terms of public examination achievement should thus be favored. In such a system, the only selectable characteristic is academic achievement and hence all pressures must be ignored except insofar as they make academic achievement a necessary characteristic. If this reasoning is accepted, these pressures are the narrow ones of examination achievement and long-term academic success.

4. *Free entry and attrition.* Some medical school admissions systems do not operate a primary selection process but allow all applicants who wish to do so to enter the medical school. Then, strict academic hurdles are erected at the end of the first and second years to cull student numbers to those who can be accommodated in the clinical segment of the course. This system effectively ensures that the only acknowledged selectable characteristic is the ability to pass examinations, the best predictor of which is, of course, the demonstration of having passed previous examinations as reflected by the academic record. As long as the only necessary characteristic that is accepted is the ability to pass undergraduate examinations, then evaluation of the system will be satisfactory. The economic and personal cost of what can be a very high attrition rate is not considered here, but is an important consideration with this policy.

5. *Academic criteria and interview.* At least in the United Kingdom, the preferred system for selection of medical students is one in which

short-listed candidates are interviewed by a selection panel. The short-listing is based on an application form requesting details of the academic record, some autobiographical and demographic data, and a formal testimonial or reference. Here it can be appreciated that the combined strategy can allow a broad range of selectable characteristics to be assessed. The problem with this method is that the vector of necessary characteristics is rarely as complete as that of the selectable characteristics, and hence the system is vulnerable to the problem that information is available to selectors which their selection policy does not explicitly consider to be important. This will, almost certainly, contaminate or influence selection, so that practice will differ from policy.

### Conclusions

We have provided a formal theoretical framework within which admissions or selection committees of medical schools may define selection policies and develop selection strategies. Medical schools must necessarily respond to a range of potential pressures which attempt to influence their selection processes; here we demonstrate that insofar as the task of selection is inherently multidimensional, no single policy or strategy can simultaneously accommodate all those forces. Nevertheless, the relative strengths and weaknesses of various policies and strategies can be made explicit within our conceptualization.

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