Can Medical Decisions Be Standardized? Should They Be?

Mario Werner

After a variety of regulatory and payment schemes have failed to stem the rising tide of health care cost, the Omnibus Budget Reconciliation Act of 1989 mandates the creation of a system of decision rules called practice parameters for appropriate medical action in many circumstances. A large body of practice guidelines already exists, but lacks the internal coherence required of a policy tool. Professional organizations therefore have developed attributes to achieve uniform style. However, little has been said or published about the constraints that might be imposed on the structure and content of an efficient and coherent system. The arguments presented here lead to the following conclusions: (a) process control is an inefficient tool to manage outcome—standards should reflect product control; (b) guidelines that proscribe are more likely to be supported by scientific data and consensus than those that prescribe; (c) the decision thresholds contained in such directives are policy choices rather than scientific imperatives; (d) neither decision analysis nor artificial intelligence is likely to readily influence medical decisions; and (e) as suggested by operations research, the development of practice parameters should concentrate on issues of therapeutic management in preference to issues of diagnostic activity.

Health care consumes an ever increasing portion of the gross domestic product in Western society. Many countries have attempted to rein in this expansion through regulations as well as legislation limiting consumption of services. Frequently, these curbs have been targeted at laboratory procedures, because clinical utilization of such resources has produced compounded annual growth rates exceeding 10%. However, the strategy to contain costs by limiting access to laboratory resources is questionable. Few segments of any industry can match the spectacular productivity gains in the clinical laboratory evidenced in the continuously shrinking time allowed for analytical tasks by the Workload Recording and Personnel Management Manual of the College of American Pathologists (1). Indeed, improved laboratory productivity has matched or exceeded multiplying demand over at least three decades.

On the other hand, the swollen flow of data has not demonstrably improved medical productivity overall. The efficiency of producing laboratory information and the inefficiencies of utilizing it thus illustrate conflict produced by the impact of effervescent technology on the activities of a humanistic profession.

In analyzing this dilemma two potential problems must be distinguished: overutilization of laboratory services and inappropriate utilization of laboratory information. Over a decade ago, Altshuler and I (2) stipulated that inappropriate ordering or overutilization of resources is not the crucial problem, because enhanced productivity can overcome it. Rather, malutilization of information is the crucial problem, because technological advances cannot correct it (2). Malutilization of data includes ignoring as well as misinterpreting relevant information and failing to integrate disparate pieces of information into an overall assessment.

Startling inconsistencies in the way physicians perceive and manage seemingly identical circumstances have long been recognized (3). More than 400 articles in a 1985 bibliography document observer variation (4). Confronted with less precise and accurate clinical data than those provided by the laboratory, observers disagree as much as half of the time concerning the nature of the observations themselves. Diagnostic, prognostic, and therapeutic estimates all differ, but a characteristic hierarchy of variability appears to exist. Diagnostic and prognostic issues produce greater variability of opinion than therapeutic and management issues. Among the latter, "black and white" decisions, such as hospitalization for acute myocardial infarction, show lesser variability; "gray zone" decisions, such as hospitalization for atherosclerosis, show greater variability.

The following examples illustrate these points. Differ-
mutability. Without the prerequisite information, practitioners are left with only personal experience as a guide, but their recall is biased to recent cases and cases with particularly good or particularly bad outcome.

The described heterogeneity of decisions that result in similar situations renders questionable the frequent argument that all cost containment must impair the quality of care. To the contrary, one can stipulate that the best of care is by definition cost-effective, because in every situation it avoids waste through correct decisions. Obviously, to eliminate all variation from health care cannot be the goal. Physicians must remain free to practice medicine as they and their patients see fit and, in the face of the protean multiformity of medical decisions, some variation indeed may be desirable (8). Rather, the target should be to reduce the differences that have no basis in either science, social preferences, or the particular circumstances of a case and to strengthen the physician's power to arrive at correct decisions. For this, physicians must be provided with the information they require; the skills to use that information must be institutionalized; and mechanisms that support, not dictate, decisions must be established (9). A number of ways to change physician behavior have been proposed, including education, feedback, consensus, administrative changes, and financial rewards and penalties, but experience evidences the limitations of all these approaches. Therefore, the concept of controlling health care delivery by a standardized system of guidelines or "practice parameters" has now gained ascendency.

Practice parameters can be defined as systematically developed statements to assist decisions by the practitioner and the patient about appropriate health care for specific clinical circumstances. Practice parameters include standards (i.e., accepted principles for patient management), guidelines (i.e., recommendations for patient management that identify a particular strategy or range of strategies), and other strategies such as practice policies and practice options (9). It has been predicted that in the near future most practice parameters will remain guidelines or options, and only the smallest part will become standards.

Process Control and Product Control

Traditionally, medicine has relied on education to ensure the quality of professional decisions. Accelerating scientific advance has imposed on physicians a lifelong obligation to continuing education, and periodic medical recertification is now being implemented. Simultaneously, a complex machinery of quality assurance and accreditation, generally focused on ensuring proper procedure, has been installed in hospitals and laboratories. However, no standardization of process can guarantee clinical or economical results. Outcome remains only a byproduct of the process control obtained from properly credentialed operators and accredited procedures. Thus, it is not surprising that efficiency generally has eluded the current system of control strategies. Control of results demands standardization of product, not process.

The introduction of prospective payment for Medicare services illustrates the differences between a process-driven and a product-driven health care system (10). In 1983, US legislation replaced itemized payment for inpatient hospital services by a new system of fixed payments for defined morbid conditions, the Diagnostic Related Groups. Profitable hospital care under this scheme depends on correct medical decisions as much as on the productivity and overhead of a provider. Figure 1 contrasts the forces driving laboratory utilization in the old and new schemes. In the traditional, process-driven system, benchmarks of proficiency are used to assess performance. Services are consciously tailored to each clinical situation, and these decisions are evaluated by their effectiveness (i.e., the prospect of fostering a desired clinical outcome). The laboratory's function is to provide data, and laboratory quality is assessed by the reliability measures of precision and accuracy. In a product-driven scheme, benchmarks of outcome assess

![Process Control Diagram](Fig. 1. Laboratory utilization in a process-driven health care system (top) and a product-driven health care system (bottom) (taken from ref. 10))
performance. Services are custom-made or standardized for the general, typical case, but may also be tailor-made if an individual case demands an exception. Decisions are evaluated by both their effectiveness and their efficiency (i.e., the prospect of fostering a desired clinical outcome through a minimum use of resources). The laboratory must provide not only data but information as well, and laboratory quality is assessed by measures of reliability and of productivity.

Given the inherent limitations of process control, it becomes mandatory to connect its instruments to outcome if one is to contain health care expenditures. The Professional Standard Review Organization (PSRO) program, mandated in the US more than a decade ago, was a first legislative attempt to create and apply outcome-based and outcome-justified practice parameters. In retrospect, the effectiveness of this massive standardization endeavor may be questioned. Assuming that hospital committees set $100,000 individual criteria in all, and that several physicians meeting repeatedly as a committee for an hour or more each time developed each criterion, it is disappointing that no library of practice parameters was created from which we could today obtain guidance on how to manage in standardized fashion any common condition, e.g., hypertension. Two reasons may explain this failure. The dispersive PSRO effort may have deprived any one group of adequate resources, because a single widely accepted guideline document could cost well over $100,000 to produce (11). Alternatively, medical practice intrinsically may be refractory to generic standardization.

In 1989, three congressional committees introduced legislation for a centralized federal effort to develop practice parameters for outcome assessment. Eventually, these proposals were subsumed in the Omnibus Budget Reconciliation Act of 1989, which establishes (a) a new Agency for Health Care Research and Policy to replace the National Center for Health Services Research as well as the Office of Health Technology Assessment, (b) an Office of Forum for Quality and Effectiveness in Health Care, and (c) an Advisory Council. The Act also provided funding, increasing from $35 million for fiscal year 1990 to $70 million for fiscal year 1992.

The mandate to standardize health care delivery at the national level has elicited two reactions among providers. A pessimistic view fears that standardization will be an initial step toward rationing resources, given that price containment has failed at cost containment. The opposite view hopes that product control through standardization will affect both quality and cost positively. According to the latter logic, quality may not necessarily reduce or contain expenditures, but quality inherently is cost-effective. However, the more fundamental issue remains whether and by what means medical decisions can benefit from standardization. This question demands an analysis of both the potential formal structure as well as the conceptual content of a system of practice parameters. Those two issues will be analyzed next.

Structuring a System of Practice Parameters

More than 20 medical societies, five voluntary health organizations (e.g., the American Cancer Society and the American Diabetes Association), and such other organizations as the Centers for Disease Control and Prevention, the Blue Cross and Blue Shield Association, and the Health Insurance Association of America have developed a body of many hundreds of medical guidelines in the US (12). Existing standards address such disparate issues as "Comprehensive Adult Eye Evaluation Preferred Practice Pattern," "Guidelines for Cost Containment in Emergency Medicine: Electrolyte Panel," "Guide to Clinical Preventive Services: Screening for Anemia." This multitude of documents varies greatly in method of development, format, content, and degree of specificity. Given that other guidelines currently are being developed, and their number is expected eventually to grow substantially, the American Medical Association (AMA) and other physician organizations have proposed five attributes to guide the development of practice parameters (9):

I: Practice parameters should be developed by or in conjunction with physician organizations.

II: Reliable methodologies that integrate relevant research findings and appropriate clinical expertise should be used to develop practice parameters.

III: Practice parameters should be as comprehensive and specific as possible.

IV: Practice parameters should be based on current information.

V: Practice parameters should be widely disseminated.

General as well as optional characteristics of practice parameters have been identified to comply with each attribute. These aggregate instructions are expected to "ensure that practice parameters are scientifically sound, clinically relevant, and applicable in the day-to-day practice of medicine" (9).

The proposed blueprint should largely codify the development and format of new guidelines and thereby foster their uniformity. On the other hand, the blueprint is silent concerning the expected utility of practice parameters, and does not specifically address their effect on outcome. Indeed, the attributes do not attempt to establish a conceptual framework by which an efficient and coherent body of health care guidelines should be constructed. Thus, the blueprint itself can be viewed as a tool for process control in the development of guidelines, rather than a tool to control outcome in health care that might result from the implementation of a system of practice parameters. That second intent demands consideration of such structural features as the following (13): May more than one practice parameter address the same issue? Should practice parameters be procedure-oriented or problem-oriented? Should practice parameters prescribe, proscribe, or both?

May more than one practice parameter address the
same issue? Many believe in the presumption that a uniquely best approach can be defined for the resolution of a good number of, if not most, medical problems, if social and economical preferences were excluded from consideration. Such a view implies that only a single practice parameter should address a given issue. However, if practice parameters are designed to foster a desired outcome, multiple parameters intended for different users with varying tasks or purposes but dealing with the same issue may be not only tolerable but indeed desirable.

To illustrate the point, consider the large number of existing guidelines that find it necessary to distinguish three categories of applicability—separately defining circumstances in which a given procedure is indicated, circumstances in which its use is optional, and circumstances in which it is not indicated. Clearly, all three rules are pertinent to a practitioner who contemplates use of the procedure, whereas only the last rule might be of practical interest to a third-party payer unless documentation of underutilization of the procedure is intended. It follows that, for different applications, practice parameters pertaining to a single issue will have different forms.

Procedure vs problem orientation. Just as quality control can be directed to process or to product, directives can be oriented either to the use of procedures, say, serum enzyme assays, or conversely, to the resolution of clinical problems, say, the diagnosis of myocardial infarction by using serum enzyme assays among all available tools. Coexistence of both types of directives demands editorial coordination to avoid conflict between overlapping guidelines. Many more existing practice parameters are procedural rather than problem-oriented, and by their very nature are directed at process rather than related to outcome. Process-oriented guidelines tend to become complex when a procedure can legitimately serve diverse purposes. On the other hand, a single preferred approach to the management of a given situation frequently can be defined, which favors simplicity in problem-oriented guidelines.

The formal impact of these contrasting editorial viewpoints can be compared in two texts. Common Diagnostic Tests: Use and Interpretation (14) is a strictly procedure-oriented compilation, comprising sections on the use of chest radiographs, electrocardiograms, blood cultures, biochemical profiles, and similar diagnostic aids. The intricate instructions produced by this approach are illustrated in a set of almost 20 guidelines assembled into a scheme of rules, subrules, and sub-subrules—just for the use of serum enzyme assays in the diagnosis of myocardial infarction. It is safe to say that few busy clinicians will without fail remember such involved directives. Clinical Diagnosis and the Laboratory: Logical Strategies for Common Medical Problems (15) shares some of the same authors with the previous text, but is a strictly problem-oriented compilation, composed of sections on syncope, pulmonary embolism, pancreatic cancer, hypercalcemia, and similar clinical conditions. This text emphasizes situations in which a statistical analysis of the probabilities of correctly ruling in or ruling out a diagnosis suggests that a single test provides the crucial diagnostic information. Clinicians are more likely to remember such simple and outcome-oriented directives resulting from this approach.

Prescribe vs proscribe. Utility studies typically are conducted among subjects who undergo a procedure rather than among subjects who present a symptom or complaint that suggests the possible use of the procedure. Accordingly, available data tend to identify potential overuse more readily than potential underuse of services. Beyond this restriction on objective information, the scientific basis for clinical decisions must inevitably always remain incomplete. Consequently, subjective opinion influences practice parameters, as is recognized in Attribute II of the AMA blueprint (12). Expert judgment also identifies agreement about useful action more readily than about useless action. Subjective as much as objective methods, therefore, formulate with greater facility those practice parameters that prescribe than those that proscribe.

Whether justified by facts or by expert opinion, guidelines must define a specific threshold at which their directives become operative. In a study of the impact of alternative decision rules (11), indications for three procedures, namely, coronary angiography, carotid endarterectomy, and upper gastrointestinal endoscopy, were compiled. A panel of physicians then rated the appropriateness of each procedure in a set of clinical cases according to the resulting list of indications. This produced classifications of appropriate, equivocal, and inappropriate use for each procedure and indication, and subclassifications of very appropriate and very inappropriate use when the experts were in consensus. However, codification of such gradings in practice parameters eludes formal rigor and cannot avoid subjective preferences that reflect the circumstances under which the choice is made: Should a given procedure be prescribed only when appropriate by the most stringent criterion of general consensus, in the larger number of cases where the majority of experts find it appropriate, or also in cases where the utility of the procedure is considered equivocal? Conversely, should the same procedure be proscribed only when inappropriate by consensus, when found inappropriate by an expert majority, or even when considered equivocal? Inevitably, such choices reflect social, economical, and other policy preferences about the desired outcome.

The Content of a System of Practice Parameters

Decision analysis, artificial intelligence, and operations research are the three available tools for formally optimizing decisions. Any guideline objectively addressing outcome probably utilizes one of these instruments. As an entire system of medical practice parameters is being developed, the characteristics of these techniques will define the limits to modeling cognitive processes. These properties must be analyzed so that resources are concentrated on implementable guidelines.

Decision analysis is based on the theory of expected
utility. Using a set of principles thought to satisfy criteria for rational choices, one can quantify the utilities or values of the various options available. The method can evaluate both diagnostic and therapeutic choices, but most applications have dealt with clinical management (16). Flow charts, decision trees, and probabilistic functions have been used to resolve such questions as whether to medicate with isoniazid young adults with a positive tuberculin test result (17-19), or whether to biopsy, treat, or wait in cases of suspected herpes encephalitis (20, 21). Although the problems are analyzed mathematically, and possibly with the use of computers, the resulting conclusions may be qualitative and their application in a clinical case may be straightforward and not require computation. However, the recommendations produced in the quoted examples differ from clinical precedent, or have produced contradictory recommendations (22, 23), even though other studies have confirmed common clinical practice.

Given the potential for discrepancies with established preferences, it is reasonable to ask whether practice guidelines in fact will guide practice. A survey of obstetricians and hospitals in Ontario before and after the release of a widely endorsed consensus statement recommending decreased use of caesarean section showed only a slight change from the previous upward trend in actual practice (24). Although one-third of respondents had reported substantially reducing the use of caesarean section as a consequence of the guidelines, their particular operative rates, when audited, actually were 14% to 49% higher than claimed. Obviously, to improve outcome, guidelines must move actual practice to the recommended behavior.

To assess the impact of recommendations resulting from decision analysis on the practices of individual clinicians managing patients, another study examined how nephrologists responded to an analysis of the utility of renal biopsy in patients with idiopathic nephrotic syndrome (25, 26). Even though patient outcome had shown that this particular option or the alternative option to use empiric steroids without invasive procedure were a toss-up, only one in six clinicians decided to forego biopsy. Linear logic thus could not overcome preferences based on clinical pattern recognition, and many physicians stressed the "pure value" of information derived from the biopsy.

In general, physicians tend to arrive at different decisions when treating a specific patient than when considering the generic case. From the individual viewpoint, physicians are more likely to spend time directly assessing the patient, order an additional test, avoid raising some troubling issues, and recommend a treatment with a high probability of success but with the chance of an adverse result (27). Just as decision analysis has been pressed to give evidence of convincing benefits of the analytical process to health outcome, decision analysis must also consider these psychological preferences. Unless the intuitive component of decisions can be managed as well as their rational component, guidelines may be viewed as the esoteric product of academic analysis, despite any conceptual appeal.

Artificial intelligence and computer-based medical problem solving have found their widest application in diagnosis (28). Such programs comprise two generic ingredients, a store of medical knowledge from which diagnostic "disease hypotheses" are derived, and an algorithm to match specific patients' data with the hypotheses. Diagnostic strategies have included flow charts, statistical pattern matching, probabilistic functions or Bayes' theorem, rule-based systems, and models of disease (29). Because the first three approaches have proven inadequate in resolving complex problems, the latter two methods have largely replaced them over time. In their simplest form, such programs proceed through three steps: (a) Whether the given findings are to be expected is determined for each possible diagnosis; (b) each possible diagnosis is scored by counting matches of expected and given findings; (c) the possible diagnoses are ranked by score. Interactive processes can expand the power of such limited evaluations. Thus, the program may inquire whether other, not yet assessed findings are present; may compare the fit of findings with that of an alternative diagnosis; or may recycle the matching process as new findings are offered.

To date, the hope of solving actual patients' problems through artificial intelligence remains unfulfilled because of two major exigencies: The number of diagnostic hypotheses under consideration should be controlled to avoid excessive demand for computation, and the likelihoods of diagnostic probabilities should be weighed. Techniques to restrict the diagnostic alternatives, on the one hand, have included a focus on the chief complaint, "triggering" by diagnostically suggestive findings, joint consideration of two findings, deactivation of unlikely hypotheses, and aggregation of hypotheses into larger entities within the context of a diagnostic hierarchy (29). Nevertheless, artificial intelligence continues to fail in the face of coexisting multiple diseases or of disorders that present overlapping findings. Dealing with the likelihoods of diagnostic and outcome probabilities, on the other hand, requires the collection and maintenance of a massive data base because risk and benefit vary significantly among population groups, and can demand separate calculations for such subgroups (22).

Operations research. The preponderance of practice parameters deals with a single diagnostic or therapeutic procedure, a setting well suited for process-oriented guidelines. Situations demanding the use of several procedures together in a group, or the use of procedures scheduled over time, to manage a clinical problem are more difficult to standardize. The management of drug-related medical problems can serve as a model to study the ease of reducing more complex strategies to algorithms.

The laboratory is involved with drugs in four ways (Table 1): the monitoring of drug therapy; emergency toxicology in accidents, suicides, and forensic problems; medicolegal toxicology in connection with the abuse of
illicit drugs; and environmental and industrial toxicology in connection with chronic poisoning. Successful management of all these situations demands integration of a clinical aspect and a laboratory aspect, with the clinical viewpoint defining the problem at hand as well as the relevant drug agents, and the laboratory viewpoint defining the sample to be analyzed as well as the assay methods to be used. A practically useful integration of the two aspects must weigh the contribution of information from either sphere to the most cogent data base, and must devise logical and efficacious clinical strategies. The degrees to which each of the four domains is amenable to standardized management cover the full spectrum of conceivable possibilities. Medicolegal toxicology connected with the abuse of illicit drugs poses very restricted and specific problems with the sole purpose of arriving at a straightforward yes–no ruling well suited to standardization. Environmental and industrial chronic poisoning, on the other hand, is so varied as to defy analysis by some standard algorithm, because each case presents its unique investigative riddle. Therapeutic drug monitoring and emergency toxicology conceptually fall between these two extremes and therefore demand further analysis.

Therapeutic monitoring decisions can be reduced to a single standard algorithm applicable to all drugs for which surveillance of blood concentration is indicated (30). This linear logic consists of the resolution of the four questions (Figure 2): Is the blood concentration within the therapeutic range? Was the sample inappropriate? Are special circumstances absent in the patient? If present, are the special circumstances reversible?

To construct a logic for dealing with emergency toxicology, a patient presenting with unexplained clouding of consciousness or coma can serve as the starting point (Figure 3). The etiological odds of this situation first call for ruling out surgical and nonsurgical conditions, and a positive answer to either of these first two questions leads into complex additional algorithms. Only a second series of decisions deals with possible toxic etiologies. Here it is proposed to first rule out endogenous toxins, and subsequently use the gravity of the patient’s conditions as the criterion for the choice of follow-up tests. If the standard assays used in an unconscious patient are all negative, additional tests may be considered. This approach produces a linear scheme of eight sequential questions, where a yes answer to any question prompts further work-up in additional algorithms. To expand the logic to emergency presentations other than unexpected clouding of consciousness or coma, one must consider situations involving any unexplained illness, any poisoning of unknown type, and any known exposure to a drug or toxic agent as starting points. Because the first part of the linear logic is tailored to a specific presentation and only its latter parts deal with the specifics of intoxication, these cases would skip a varying number of initial questions. Thus a comprehensive algorithm could be likened to a tree with ever-dividing branches (i.e., presentations) and roots (i.e., managements), con-

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### Table 1. The Four Prototypes of Drug-Related Medical Problems

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Clinical problem</th>
<th>Agents</th>
<th>Sample</th>
<th>Primary methods</th>
<th>Data base</th>
<th>Clinical strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drug therapy</td>
<td>Monitoring</td>
<td>Cardiacs, bronchodilators</td>
<td>Blood</td>
<td>GC, HPLC, immunoassay</td>
<td>History, drug regimen</td>
<td>Management algorithm</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
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<td>(Fig. 2)</td>
</tr>
<tr>
<td>Toxicology</td>
<td>Emergency</td>
<td>Therapeutic drugs, alcohol, illicit drugs, poisons</td>
<td>Gastric aspirate, blood, urine, breath</td>
<td>Thin-layer chromatography, GC, HPLC, immunoassays</td>
<td>History, clinical information, quantitative and qualitative laboratory information</td>
<td>Diagnostic algorithm</td>
</tr>
<tr>
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<td>(Fig. 3)</td>
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<tr>
<td>Medicolegal</td>
<td>Abuse of illicit drugs</td>
<td>Amphetamines, opiates, cocaine, methadone</td>
<td>Urine</td>
<td>Thin-layer chromatography, immunoassays</td>
<td>Qualitative laboratory information</td>
<td>Generic yes–no ruling</td>
</tr>
<tr>
<td>Environmental and industrial</td>
<td>Chronic poisoning</td>
<td>Metals, organics</td>
<td>Blood, urine, tissue, faces</td>
<td>GC with electron capture, HPLC, AAS, special procedures</td>
<td>History of exposure, confirmation by laboratory, ± clinical information</td>
<td>Individualized diagnostic approaches</td>
</tr>
</tbody>
</table>

GC, gas chromatography; AAS, atomic absorption spectroscopy.

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**Is blood drug concentration within the therapeutic range?**

- **Yes**
  - Repeat assay on appropriate sample
  - Adjust dosage regimen and recheck it

- **No**
  - Was the sample inappropriate?
    - **Yes**
      - Correct circumstance and recheck response to dosage
    - **No**
      - Are the special circumstances reversible?
        - **Yes**
          - Adjust dosage regimen and recheck it
        - **No**
          - Are special circumstances absent in the patient?
            - **Yes**
              - Correct circumstance and recheck response to dosage
            - **No**
              - All is well

Fig. 2. Algorithm for therapeutic drug monitoring (taken from ref. 30 with permission)
The variable case of reducing drug-related clinical problems to algorithms allows an important generalization. Each problem involves diagnostic as well as therapeutic considerations, but the relative weights of these two components differ among the four described prototypes. In both the medicolegal toxicology of drug abuse and the toxicology of chronic poisoning, diagnostic concerns predominate. At the same time, the construction of conceptual algorithms offers little promise; in the first case the problem is so simple as to render the task trivial, and in the second case so complex as to render it impracticable. In emergency toxicology, where therapeutic management is a concern at least equal to diagnosis, a useful but complex universal decision and action algorithm can be developed. Finally, in therapeutic drug monitoring, where only a few diagnostic options must be considered but proper management is paramount, a simple yet effective decision-and-action algorithm is available. These relationships suggest that at present therapeutic management is a more promising field for complex practice parameters than diagnostic activity.

References

22. Moulding T. Decision analysis, public health policy, and iso-