Learning While Caring: Medicine’s Epistemology
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ABSTRACT

An essential epistemic consideration is the conditional nature of medical knowledge. This uncertainty must be understood when acquiring new knowledge or designing treatments. We must value all sources of information, neither discarding those deemed lower on the current value scale, nor slavishly accepting randomized clinical trials or their meta-analyses as the fount of all knowledge. Generally, the tension between clinical investigation and individual care can be framed in a utilitarian versus deontologic or rights-based philosophy. The utilitarian is clearly appropriate to public health considerations, but what is learned for public health may not necessarily be in the best interest of an individual patient. In utilitarianism, the distribution of goods—in this case, health—is not important; rather, it is the amount of total good gained that is to be maximized. Too often we assume that survival or cure is a sufficient metric, with no similar quantitative measure of other factors. This often leads to the so-called best treatment being not what the patient wants. All personal care requires consideration of both the helpful and harmful consequences of treatment in the context of individual patient comorbidity, preferences, and fears. Knowledge of patients in general is not what is required; rather, it is how to apply the information to the particular patient that is the heart of medical practice. Each patient’s episode of illness is the consequence of a unique interaction of that individual with the disease. Good patient care considers the disease and its management in the context of each patient’s values.

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INTRODUCTION

Physicians have a responsibility to continue their professional education while they practice medicine. Learning while caring for patients must be consistent with their responsibilities as physicians as well as with patient’s health care rights. Epistemology, the study of knowledge and justified belief, is especially relevant to how physicians learn and apply this knowledge to the individual patient. This essay considers some of these methods of learning and the nature of that knowledge. Because my interest is in oncology, the examples used are from that field, but I am confident that similar ones could be found in many other fields of medicine dealing with serious illness.

The medical profession accepts that although intensive preparation is essential, much of what is taught in medical school needs to be discarded, corrected, or modified throughout the physician’s career. New knowledge changes our understanding of disease and its management, and life-long learning is essential to continue to practice properly. Continuing evolution of knowledge is meant to modify that acquired during one’s medical education and postgraduate training. Medicine is a program of lifelong learning, but for the practitioner, this must be acquired while caring for patients. New medical knowledge comes from reading the literature, both print and electronic, and from presentations at professional meetings. It comes from the teachings of leaders in the profession; it comes from clinical experience in the aggregate as well as from individual patients. All of these sources may provide some new evidence or concept leading to improved knowledge so as to treat future patients more skillfully. Medicine is a learned profession, but perhaps more importantly, it is a learning profession.

An essential epistemic consideration is the conditional nature of medical knowledge. It is not binary. We are neither completely ignorant nor reasonably certain. In reality, our knowledge is conditional, is often approximate, and varies over a wide spectrum of confidence. Karl Popper tells us that the inductive method may give us an increasingly more satisfactory approximation of truth, but knowledge derived inductively is always conditional and subject to being disproved. The conditional nature and thus the uncertainty of medical knowledge must be understood when either acquiring new knowledge or designing patient treatment.
During the last few decades, there has been a new emphasis on the valuation of medical information resulting in a hierarchy of the quality of medical evidence. This critical assessment of the evidence used to change medical practice has led to evidence-based medicine, an epistemologic consideration of the quality of medical knowledge. In general, the National Institute for Health and Care Excellence (NICE) in the United Kingdom and similar US agencies have developed hierarchies of medical knowledge, with randomized clinical trials and their aggregating meta-analyses as the most estimable evidence, and case reports, individual experience, and expert opinions as the least satisfactory methods of attaining knowledge. Although there have been some disagreements with the notion that randomized controlled trials or that meta-analyses of such trials should produce necessarily better data than well-designed observational trials, their priority seems well accepted. We should be careful to regard all sources of information as worthwhile, neither discarding those considered to be lower on the current value scale, nor slavishly accepting randomized clinical trials or their meta-analyses as the fount of all knowledge. All information may be useful if critically appraised. A poorly conceived or performed study high in the hierarchy is less meritorious than a well-done, less fashionable study. Whatever the relative value of the different sources of information, they all contribute to the physician’s knowledge. How these multiple sources are combined is the heart of interpretation, some of which may be tacit rather than explicit. Polonyi2 believes that these actions are not just deduced from the information, but rather, when combined with tacit knowledge, they provide more knowledge than the explicit information alone. Although related, the acquisition of knowledge is different from clinical judgment and knowledge gained from personal care; this essay is about learning in the context of clinical practice and research. Clinical judgment uses this knowledge combined with experience and the clinical circumstances. Personal care modifies this judgment with consideration of the patient’s wishes, as well as other clinical and social circumstances. Forming clinical judgment, Quirk1 emphasizes, involves intuition and metacognition; the former is rapid and unconscious, whereas the latter is deliberate and conscious. However, this knowledge of patients in general is not what is required for practice; rather, it is how to apply the information to the particular patient that is the heart of medical practice.

“Those who cannot remember the past are condemned to repeat it,” Santayana admonishes us.4 Nowhere is this truer than in medicine. Past experience, both of the individual physician and of others, as reported in the literature or in person, can be an important guide. Clinical experience, individually and even more importantly when collected, can be a rich resource for the physician and educator. Unfortunately, there are many pitfalls having to do with patient selection criteria and observer bias. One physician’s selection criteria may result in favorable outcomes, but the clinical judgment in his or her selection is often not apparent in published reports or lectures. Despite its limitation, learning from one’s own clinical experience is often the most powerful educational instrument used.

Information about past patients can also be considered at a later time, as new techniques become available. Such “old wine in new bottles” may provide extraordinarily valuable information: for example, applying new molecular techniques to archival pathologic material and then correlating them with prognosis and the results of the treatment applied. Such studies are especially important because of the limitation of prospective trials of diseases with a long natural history.

Because this technique, with its aggregating meta-analyses, is considered the most important and reliable source of medical information, we should consider some of the problems with the method. Although I have discussed elsewhere my concerns with the potential ethical conflict imposed by this study design—between the patient’s rights in health care and the professional obligations of the physician on the one hand, and the potential societal benefit of the knowledge gained on the other3—there are some epistemic limitations to this method as well. The more we subdivide patients into smaller and presumably more homogeneous groups, the more cumbersome the randomization and the more patients required in the experiment. With the increasing use of molecular tools to discriminate smaller, more homogeneous subgroups, there will be more groups, but many fewer patients in any particular group. Conversely, the more we lump patients into larger heterogeneous groups, the more unlikely the results will be applicable to individual patients and the less appropriate the knowledge gained will be for individual patient care. Randomized trials often require large numbers of patients to detect a statistically significant difference, resulting in a logistic hurdle that is often solved by multi-institutional collaboration. Unfortunately, this adds to the heterogeneity of patient groups and increases concerns about the uniform application of the study design. One highly valued solution to the problem of insufficient power of individual trials has been the use of the meta-analysis, but this only exaggerates the problem by aggregating patients into large, heterogeneous groups.

Meta-analysis also depends on the premise that various studies can be considered together if they have a common variable: that is, being randomized. This is only true if the same theory of disease underlies the hypothesis being tested; otherwise, the results can be quite confusing. The individual studies in a meta-analysis may have the same variable but compare different classes of patients, often while asking different questions. For example, there have been extensive meta-analyses of the use of postoperative radiation therapy for breast cancer. In these meta-analyses, both patients who received systemic adjuvant therapy and those who did not are often combined because, in both types of studies, the administration of radiation therapy is the randomized variable. However, the studies in which all patients receive adjuvant systemic therapy and are then randomly assigned to postoperative radiation therapy are testing a hypothesis based on a different theory of disease spread than those studies of patients not receiving systemic agents. In the latter case, the question being asked is whether the destruction of persistent subclinical disease in the breast, chest wall, and lymph node areas is important because it is the source of subsequent metastases. Although in the case of the uniform use of adjuvant systemic therapy, randomizing postoperative radiation therapy is testing whether such systemic treatment, by eliminating previously disseminated occult metastases, allows regional irradiation to...
effectively eliminate residual tumor as an important source of subsequent metastases. In this case, regional irradiation may be unimportant without effective adjuvant treatment because of the extent of microscopic metastases disseminated before the regional irradiation. Such a notion posits that only when systemic agents destroy these preexisting disseminated tumor cells does the ablation of regional disease have an impact on metastatic spread and, ultimately, on survival. Thus, these studies could be positive, whereas those studies not using adjuvant systemic therapy are negative. Such differing results in studies with the same variable being examined would not be inconsistent. The reverse might also hold true: that is, regional irradiation might only be important when adjuvant systemic treatment is not administered. Finally, both of these may be true but for different patients. Combining both types of studies will obscure the evaluation of the study results. This is an example of flawed meta-analysis. Frei et al. also question the early use of randomized clinical trials before the treatment to be studied has been optimized. They refer to studies of neoadjuvant or combined chemotherapy with surgery or irradiation in the treatment of head and neck epithelial neoplasms. Such early trials using lower doses of drugs may be negative and, when included in a meta-analysis, may cause a negative result when proper treatment truly is beneficial.

There are problems with the use of prospective randomized trials when the outcome can only be determined after a long period of time. Randomized trials to determine the appropriate treatment of early prostate cancer are unlikely to be helpful, because it will take such a long time for differences to be determined that the treatment techniques will have significantly changed, resulting in the study results having only limited application. Alternative study designs such as analysis of patients matched by known relevant characteristics may be especially useful. If an independent party does the matching, observer bias is minimized. The limitation is, of course, that there are hidden relevant factors that are not evenly distributed between or among the study groups. The ability to repeat these studies without ethical concerns may reduce this problem. No study design is perfect. All require confirmation, but the advantage of this design is that it can be done either prospectively or retrospectively. Retrospective analyses may have more problems with selection bias, but they can be done repeatedly to different data sets to confirm other studies without incurring any ethical difficulties. They are also useful when the disease has a long natural history, and intermediate markers are not available. Any prospective trial is a poor tool in these circumstances.

Underlying the randomized clinical trial is the a priori acceptance that it is the null hypothesis that must be disproved to accept a change in practice. The null hypothesis serves the study by reducing the likelihood of false-positive results, but it does so at the expense of increasing the possibility of false negatives. This may be useful in some circumstances, but it may not always be the desired bias, especially when there is no satisfactory therapy for a fatal disease or when related information suggests that a real difference between groups is more likely than no difference. In serious illness, where the consequences of the current treatments are uniformly bad, rather than fear the adoption of a therapy that is ineffective, we should be more concerned with the premature abandonment of a therapy, which might have some value. Rather than minimizing the likelihood of a false positive resulting in acceptance of an ineffective treatment, we may want to ensure that no false negatives result in discarding potentially valuable therapy. The balance between these two ways of forming the question—minimizing false positives versus minimizing false negatives—also depends on previously acquired knowledge and the consequences of the two strategies. When there is little reason to suspect an intervention to be valuable, and the costs both financial and in morbidity are great, then one should begin with the null hypothesis and reduce false positives. But if the costs of falsely accepting the value of an intervention are small, or prior information suggests the intervention to be valuable, then the proper hypothesis to be tested is that the intervention is of value, and it is this that must be disproved. Bayesian statistical analyses are designed for incorporating previous knowledge, but medical reports seldom use them. An example of the questionable acceptance of the null hypothesis is its use in assessing the value of mammography in young women. One might argue that although there is some disagreement, many studies demonstrate that screening mammography reduces breast cancer death by 25% to 30% in women age 50 to 70 years, and therefore, this benefit is likely to be obtained in younger women as well. This bias does not reject the possibility that the technique has no value in this group, but rather, it determines what the hypothesis to be tested should be. Framing the question this way changes the burden of proof dramatically, because the study must be designed to reject there being a meaningful difference rather than requiring that the difference be proven. Selecting the proper hypothesis to be tested also depends on the purpose of the study. In the case of mammography for the 40- to 50-year-old woman, adoption of this technique for population-based screening might require disproving the null hypothesis, because the financial consequences of widespread mammographic screening as a public policy would be large. Furthermore, because the incidence of breast cancer is much lower in women in this age group, screening will be less productive, will result in more false positives with the attendant unnecessary additional diagnostic studies, and ultimately may benefit fewer women. This conclusion is pertinent to general public health considerations. However, the application of mammographic screening for the individual young woman might be more properly informed by the a priori assumption of there being a similar benefit as seen in older women. This is especially so because the disease is more aggressive in young women, rendering early diagnosis to be of more potential value. Not only does the application of the knowledge differ when used for the individual patient as compared with public policy, but the assumptions in the testing are also different.

Generally, the tension between clinical investigation and individual care can be framed in a utilitarian versus deontological or rights-based philosophy. The utilitarian is clearly appropriate to public health considerations, but what is learned for public health may not necessarily be in the best interest of an individual patient. In utilitarianism, the distribution of the goodsex—this case, health—is not important, but rather, it is the amount of total good gained that is to be maximized. In contrast, for the physician caring for the individual patient, the distribution of goods is all important because the patient’s rights in health care must be the physician’s primary concern. We can see the dichotomy clearly in considering mammography in younger women. Although the cost-benefit analysis appropriate for a utilitarian view of a screening procedure might show it to be too expensive for the life-years gained when adopted as a population screening program, individual physicians might still decide to use that screening technique to offer the patient as much benefit as possible. This has led
to the widespread use of mammography in patients between age 40 and 50 years, despite there being no uniform public policy for recommending population screening in this age group.

**TECHNOLOGY**

The rapid advances in technology and biotechnology are continually revising the current state of medicine. Arguably, the major medical advances made in the latter half of the 20th century are a result of the increased ability to diagnose disease as a consequence of major developments in diagnostic imaging and laboratory medicine. Not only do these modalities provide deterministic diagnostic information, they also provide tools to assess the extent of disease, thus influencing the design of the treatment. The pace of improved technology and emerging biotechnology provides a challenge in determining their clinical usefulness. A suggested framework for doing this while caring for patients is to separate proximate and ultimate utility. By proximate utility, I mean does the method do what it is designed to achieve? For example, does computed tomography diagnose pancreatic cancer better and at an earlier stage than clinical examination? Estimating ultimate utility requires determining whether such earlier diagnosis will improve treatment outcome. The former is easily ascertained, but the latter is far more complicated. Ultimate utility is only determined in an iterative fashion, which may depend on continuing improvements in diagnostic technology leading to new therapy or even to making previously ineffective treatment useful when its effectiveness depends on the extent of disease. Because the determination of ultimate utility is an evolving process that will take time, I suggest that we accept evidence of proximate utility as sufficient to begin to determine clinical utility. Requiring effectiveness too soon may result in abandoning what might have been an important clinical advance. Unfortunately, there is little benefit in the early diagnosis of pancreatic cancer, but to abandon technology able to provide its earlier diagnosis would reduce the likelihood of developing innovative therapy for such early-stage disease. Although ultimate utility is the goal, this should not denigrate surrogate markers—often measures of proximate utility—because these may better serve to directly measure the effectiveness of the early detection and tumor evaluation technologies. Only after this utility is established can the new method be tested for clinical usefulness. Plain chest radiographs have not been shown to be useful for lung cancer screening, but there are data supporting the use of modern computed tomography for that purpose. The limited benefits of surgery for lung cancer detected by conventional means seem to be markedly increased by the early detection provided by currently available, rapidly acquired helical computed tomography. A representative biotechnologic advance is the ability to test for breast cancer susceptibility genes. *BRCA1* and *BRCA2* have proximate utility by determining risk and developing strategies to reduce this risk through removal of targeted organs, but we are still searching for their ultimate utility: the reversal of the action of the mutation to decrease cancer risk without mastectomy and oophorectomy. This may come with the development of specific treatments designed to address these mutations or their protein products. Learning in medicine about the uses of technology and biotechnology needs proof of proximate utility and then the freedom to innovate for ultimate utility.

**PERSONAL CARE**

To pursue our obligation to personal care we must first consider the individual patient’s goals.7 The physician needs to determine the relative importance to the patient of the achievement of each of these goals. For example, how important is cure of the disease as compared with relief of the symptoms? How distressing is the morbidity produced by the disease or potentially by the treatment contemplated? How does the patient value various bodily functions and appearances that may be affected by either the disease or the treatment? This constellation of relative values is individual to each patient and likely to vary greatly among patients. Furthermore, because of the differences in patient comorbidity, goals of treatment, and individual values, it is not possible to have a treatment algorithm specific for the care of patients other than in the most generalized form. Combining patients into groups restricted or coerced by insurance rules, investigational protocols, or algorithms for care and assigning a common treatment may be contrary to personal care. When considering the patient with breast cancer, although it is quite easy to place the patient into appropriate stage grouping, and although there may be treatment recommendations for each stage in general, these are regularly modified, not only by how the particular patient fits into the stage. Montgomery8 considers the problem of particularizing in determining clinical judgment, but particularizing must also involve the patient’s desires and comorbidity. Because there are many goals of treatment, survival—the most commonly used measure of success in cancer management—is not sufficient for determining what is best for the individual patient, nor is it necessarily the best parameter for selecting a patient care program or for evaluating clinical results. The evaluative criteria must incorporate quality-of-life considerations and patient values in individualizing patient care. All too often we assume that survival or cure is a sufficient metric, with no similar quantitative measure of other factors. This often leads to the so-called best treatment being not what the patient wants. These issues are illustrated in studies of patient treatment preferences comparing early versus long-term survival in patients of different ages treated by radiation therapy or surgery for lung cancer9 and the willingness of some patients to accept a reduced likelihood of cure for better voice preservation.

All personal care requires consideration of both the helpful and harmful consequences of treatment in the context of individual patient comorbidity, preferences, and fears. In practice, we must consider the quality of life, the patient’s risk-taking preferences, and how the imposition of treatment and continued management will affect the patient’s life. To understand a person with an illness, one must do so considering the whole organism, not only a molecular aberration or even a diseased organ system. Social and societal considerations are essential to understanding a patient’s illness and designing appropriate care. For example, useful speech is of such value that to some people it is worth sacrificing some likelihood of survival from laryngeal cancer. Most interestingly, this varies among and within social groups, as was shown by a study comparing management executives with firefighters.10 The former are willing to sacrifice more survival likelihood to retain useful speech, but in both groups, there was extensive individual variation. Each patient’s episode of illness is the consequence of a
unique interaction of that individual with the disease. Good patient care considers the disease and its management in the context of each patient’s desires, wishes, and values. Relying on information limited to disease control or survival without considering the patient’s goals is not personal care, nor is it in the best interest of the patient. Aristotle\(^1\) reminds us that learning in general must be modified to be useful for the particular: “Nor is prudence a knowledge only of general principles, but it must also know the particulars; for what are practical and action are always about the particulars.”

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REFERENCES

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