Introduction: What Is the Science of Medical Decision Making?

Medical decision making (MDM) refers to the process of clinical reasoning that is used to make estimations of, and decisions regarding, patient diagnosis and treatment. Although as we will see in this chapter, this process is often complex, it is nevertheless used throughout clinical practice from routine primary care cases to complex cases encountered in specialty clinics and emergency departments. Because all clinicians engage, either formally or informally, in the process of medical decision making, the study of this process is important both for those who practice medicine as well as for those, such as philosophers of medicine and decision analysts, who aim to understand and improve it. Thus, the goal of this chapter is to provide an introduction to medical decision making that is relevant to both medical practitioners and philosophers of medicine.

The process of MDM generally begins by working toward a diagnosis of the patient’s problem or illness. This means that MDM involves the consideration of how to understand and characterize information gained from the medical interview and physical examination of the patient, as well as decisions regarding whether and which diagnostic tests or procedures to use when considering the possible causes of a patient’s problem, and how to best interpret these tests. In some instances, a clinician might make a diagnosis and suggest treatment based on the interview and exam alone, whereas in many others, diagnostic tests or procedures may be required during the process of differential diagnosis, which is a probabilistic method of diagnostic reasoning used to rule in or rule out diagnostic options. When considering whether or not to perform diagnostic testing, the first concern is with test or procedure accuracy. This is a function of the specificity (how well the test excludes patients without disease) and sensitivity (how well the test identifies patients with disease) of the diagnostic. In some instances, data from randomized controlled trials (RCTs) might be used to determine test or procedure accuracy, whereas in other cases, observational studies are used.

Even once a diagnostic test is found to be accurate—that is, once it is found to provide reliable epistemic information about the patient’s condition—the question of whether or not it is worth performing remains. Some medical textbooks simply state that, “test selection should be restricted to those diagnostic tests whose results could change the physician’s mind as to what should be done for a patient” (Sox et al. 2007). However, the situation is often not as simple...
as this. For instance, in many cases, patients want to know what is wrong with them (Bossuyt et al. 2009), even when a treatment for their illness or condition is not available. Further, clinicians are divided over whether an accurate test for an untreatable disease should ever be performed. Whether or not it should depends on how we understand value in the medical context—for example, whether we believe that medical value is tied inextricably to patient outcomes, or whether we believe that a test that provides knowledge is valuable in some epistemic sense even when it does not lead to improved patient health.

The most generally accepted position in current medical practice is that, unless performing a test will lead, via treatment, to an improved patient outcome, it should not be performed. However, the information provided by diagnostic testing does not, on its own, have a direct effect on patient outcomes (although it can have positive or negative indirect effects on the patient’s mental state; see, e.g., Cournoyera and Kennedy 2014). Rather, it is what we do with this information that has an impact (positive or negative) upon the patient’s health. Thus, in order to determine whether or not performing a test will in turn lead to improved patient health, one needs to know whether or not a given diagnostic test is a good predictor, not only of the condition it is intended to diagnose, but also of treatment outcomes for this condition, and thus this consideration too must enter into the medical decision-making process: one might decide to perform a test only if it has been shown to not only accurately diagnose a given condition, but also to lead to improved patient health in those with the condition it diagnoses.

Once a patient’s condition has been diagnosed, medical decisions regarding treatment must then be made. Treatment decisions can be quite complex and involve evaluating (generally on the basis of data from RCTs or observational studies) whether or not a treatment is therapeutically effective, whether or not it is affordable, whether or not it will interact with other patient treatments and/or comorbid conditions, and whether or not the long-term benefits and/or effects of the treatment are in line with patient expectations and values. Because RCT or other clinical study data is not always available, or because, in some cases, it is not clear whether or not the available data is applicable to a particular patient, in practice, clinicians must often decide whether or not to begin treatment for a condition despite being unsure of the diagnosis or of the way the treatment will ultimately affect the particular patient.

Before making the decision to begin treatment, the clinician must consider both the risks and the benefits of the proposed treatment, as well as the patient’s attitudes toward these risks and benefits. Then, on the basis of this information, the clinician must decide whether to continue gathering information in order to make a more certain diagnosis, to observe the patient without treatment, or to begin treatment of the patient’s (potential) condition.

The long-term prognosis of the patient’s condition must also be taken into consideration when deciding whether or not to begin treatment. The term “prognosis” describes the probability that a patient with a specific clinical profile will develop a certain health outcome over a period of time. Prognostic information is helpful for deciding when to start and when to stop treatment and for monitoring disease progression or remission, and symptomatic improvement or worsening. Further, an accurate prognosis can also be invaluable for selecting the most effective treatment for an individual patient. However, the reliability of currently available prognostic tests is limited, and thus, in many instances, prognostic estimations must be made on the basis of very limited data.

As we will see in the example that follows, many decisions need to be made regarding diagnosis and treatment in each patient case. In order to facilitate these decisions, the science of MDM draws on insights from decision science, economics, probability theory, and theoretical models of the clinician-patient relationship and shared decision-making. Thus MDM incorporates both quantitative approaches, such as using Bayes’ Theorem to determine pre- and post-test probabilities, and qualitative approaches such as discussing with the patient his or
her values when estimating the expected utility of a given diagnostic test or treatment plan. Further, the process of MDM involves both the concerns of the clinician (such as the harms vs. benefits of a test or an intervention) as well as those of the patient (such as how the patient feels about these harms or benefits). As such, MDM is a science that can be understood only from a multidisciplinary perspective.

**Example**

In order to better understand both the process of MDM in clinical practice and the philosophical issues that this process raises, it is helpful to consider an example. Let us consider the following plausible scenario:

A 32-year-old male presents to the ENT clinic with facial pain, fatigue, low-grade fever, and a history of chronic/recurrent sinusitis. Further, he reports that he experiences six to ten such infections per year and has so continuously for the past 5–6 years. These infections have been diagnosed via computerized tomography (CT) scan and treated by his primary care physician with 10–14 days of antibiotic therapy. The infections resolve successfully (temporarily), only to return after a few weeks or months. The patient has also undergone allergy testing, with no significant environmental allergies documented. The patient is frustrated and expresses a desire to find the “cause” of his ailment so that the recurrences of sinusitis can be stopped.

**Encounter to Differential**

In this section we will see how a clinician might use the process of MDM to initially evaluate a patient and create a list of possible diagnoses. In our example, the patient has expressed a clear desire to know why he has recurrent infections, so that they can be stopped. Thus, this clinical encounter will begin, as most do, with a medical interview in order to gather evidence toward making a diagnosis of the cause of the patient’s recurrent illness. The questions asked of a patient during this interview will differ depending upon the presentation and the specific patient circumstances. In some cases, such as in the emergency setting, there will be little time for questioning at all, and the clinician will proceed directly to physical exam. In our specific example, however, the situation is not emergent. Instead, the pressing matter is to determine why the patient’s infections are recurring so they can be stopped. If the clinician in this case works on the assumption that the patient’s infections were properly diagnosed, and did in fact respond to antibiotic therapy, then he or she would next need to perform a physical exam to see if further diagnostically relevant information can be obtained. However, with sinusitis, as with many conditions, the ailment cannot be diagnosed on the basis of an exam alone. A patient who presents with recurrent nasal swelling, sore throat, fatigue, and lymphadenopathy, for example, could be suffering from a number of illnesses, including viral upper respiratory tract infection, allergies, or bacterial sinusitis. However, a patient who has a history of documented bacterial sinusitis, and does not have environmental allergies, is more likely to be experiencing a recurrence of this condition rather than a viral infection. Absent the history of bacterial sinusitis, the opposite would be true (a viral infection would be more likely). Thus, one can see how in this instance, as is again the case with many others, the diagnostician must use the information gathered from the patient history in conjunction with clinical data to make a diagnosis—clinical data alone would not be enough to ensure accuracy in diagnosis.

In this particular example, the clinician, based on patient history and a physical exam, could reasonably rule out causes for the patient’s condition other than recurrent bacterial sinusitis.
and then diagnose the patient with this condition. Once the patient has been diagnosed with recurrent bacterial sinusitis, the clinician will not only need to treat the current infection but will also need to investigate the underlying cause of the recurrent infections, with the goal of making a causal diagnosis that will facilitate resolution of these infections.

Causal diagnoses (as opposed to label or syndromic diagnoses), particularly those that posit pathophysiological mechanisms, are considered to be the gold-standard for medical diagnosis (Smith and Francesca 2007), because it is thought that understanding the underlying pathophysiology of an illness best allows for effective treatment. In this particular case, uncovering the underlying reason for the recurrent bacterial sinus infections is important, because unless the cause of the issue is identified and treated, the infections will most likely continue to recur. This case, in that aspect, is again representative of others, because often the initial reason that a patient presents in the clinic does not automatically reveal the underlying cause of the ailment in question.

In order to try to find the underlying pathophysiological cause of a patient’s complaint, the clinician will often begin by making a list (known as the “differential”) of the most likely predisposing conditions. For chronic or recurrent sinusitis, these include:

- Allergic reactions (which cause the nasal passages to swell)
- Nasal passage abnormalities such as nasal polyps or a deviated septum
- An immune system disorder (either acquired or primary)
- Asthma

Although there are certainly other possible underlying conditions, the initial differential list is composed of only the most likely ones. If all of the conditions in the initial differential are eventually ruled out, then the clinician will create a new differential that includes other, less likely, conditions.

In order to eliminate conditions in the differential and eventually arrive at an accurate diagnosis, the clinician needs to evaluate, either formally or informally, the probability of each of the conditions individually. This is generally done via an appeal both to personal experience and to published data. Personal experience in the clinical setting provides a wealth of knowledge that can assist in making a diagnosis. Published data can also provide diagnostic evidence. However, while both sources of evidence are important, both are subject to biases. In the former, the biases include physician overconfidence (which can lead to a disinterest in investigating supplemental decision support), a tendency to assume that the current patient has a condition that the physician has previously seen, and premature closure, which is the narrowing of the diagnostic options too early in the process of differential diagnosis so that the correct diagnosis is never seriously considered (Berner and Graber 2008). In the latter case, the biases most often result from faulty clinical trial design (Emmanuel, Wendler, and Grady 2000) or from an assumption that the available trial data is applicable to a particular patient when it is not.

Further, there is often disagreement among clinicians about the relative probabilities of the conditions in the same differential. This disagreement is due both to differing personal experiences and to the fact that different clinicians read different journals. For instance, the primary care physician is more likely to read articles in primary care journals, which report the prevalence of disease in unselected patients, while specialists, on the other hand, more often read journals that report studies of patients who have been referred to specialists. Understanding the prevalence of each of the conditions in the differential is pivotal in facilitating a correct and timely diagnosis.

Once probabilities (either formally or informally) have been assigned to the various conditions in the differential, the clinician must then decide what diagnostic testing to perform in
order to decide between them. Of the conditions on the list in our example, allergies and structural abnormalities are far more common than primary immunodeficiency diseases. Because of this, they should be investigated first and, in this case, can be ruled out on the basis of previous allergy testing and CT scan evaluation, respectively. Asthma, which is also more common in the general population than immunodeficiency disease, can in turn be ruled out via a careful patient history and/or simple testing. This leaves only immunodeficiency disease in the differential. Although it is the last to be ruled out, this does not mean that the patient definitely has such a condition, but it does raise the probability that he does, especially given the frequency of bacterial infection reported (which would be uncommon in someone with a well-functioning immune system).

At this point in the diagnostic process the clinician will then form a new differential that includes both HIV/AIDS (the most common form of secondary immunodeficiency) and common variable immune deficiency (the most common form of primary immune deficiency). Given this new differential, the physician will then proceed to diagnostic testing in order to gather further evidence toward a diagnosis.

Obtaining and Interpreting Diagnostic Information

Since the clinician in this case suspects an immune disorder, she or he will want to use diagnostic testing to determine the likelihood that the patient has one of these conditions. Importantly, this likelihood, or probability estimate, depends upon both the pre- and post- test probability that the patient has the disease in question. The pre-test probability of a disease is the probability that disease is present before any testing is conducted. This probability will depend upon whether or not, given the patient history, the patient is in a high- or low-risk group for the condition in question. The post-test probability of a disease depends upon the pre-test probability as well as the accuracy (sensitivity and specificity) of the test that is being performed. Thus, there is no such thing as being absolutely certain of what a test result means; it varies from one patient to another depending on his or her pre-test probability. Having a positive test result does not necessarily mean that a patient has the condition, nor does having a negative test result mean that the patient does not have the condition. However, clearly, these results do affect the likelihood of whether or not the patient has the condition that the test is intended to diagnose.

Suppose that the patient in our example is in a low-risk group for secondary immunodeficiency due to infection with the HIV virus and is also seronegative for the virus. In that case, the clinician can reliably remove this condition from the differential list. Of course, as we have noted, even with a negative test, one cannot be certain that the patient isn’t infected with HIV, but when the pre-test probability of the condition is low, and the test is negative, the likelihood of the patient having the disease is very low.

Once secondary immune deficiency has been ruled out, the possibility of a primary immunodeficiency in a patient who has frequently recurring infections of the skin or respiratory tract should be investigated. There are more than 200 primary immunodeficiency diseases recognized by the World Health Organization. Common Variable Immune Deficiency (CVID), so named because it is the most common one (but still very rare, according to the National Institutes of Health the incidence in the population is approximately 1 in 25,000 to 1 in 50,000 people worldwide, although the prevalence can vary across different populations) can be tested for with simple and relatively inexpensive serum tests, as it is characterized by low levels of serum immunoglobulins. The low level of these antibodies in CVID is the underlying cause of the increased susceptibility to infection in patients with the condition.

Further, patients with CVID also have an increased incidence of autoimmune or inflammatory manifestations and susceptibility to cancer when compared to the general population.
The diagnosis of CVID is usually made in the third or fourth decade of life, so this condition should be suspected in patients of this age who present with any of the above conditions.

In our particular example, the patient has at least two markers that increase the pre-test probability that he has this condition: frequent respiratory infections (Wood et al. 2007) and age in the mid-thirties. Thus, diagnostic testing for CVID, given the above markers, seems reasonable in this specific case, particularly since it is minimally invasive and relatively inexpensive, even though it would likely not be warranted in most people who present with acute bacterial sinusitis.

In some cases, a physician might elect to conduct an empirical trial of a suspected condition instead of opting for diagnostic testing. However, in the case of CVID, the testing for the condition is relatively inexpensive, while the treatment is not. Thus, in this particular case, it is better to have more decision support for treatment (in terms of a positive serum test) than to elect for an empirical trial without further testing.

Testing for CVID involves measuring the levels of IgG (and sometimes IgM and IgA) in the serum. If the levels are low, then the patient is treated with replacement IgG, generally either monthly intravenously or weekly subcutaneously at a cost, in most cases (depending upon dose), of more than $20,000 per year. Because of the difficulty and expense in treating CVID, the clinician will want to be as confident as possible in the diagnosis. Although all medical diagnoses are at some level uncertain, a clinician must be confident that she or he is at least “approaching a solution” before initiating treatment (Barrows 1991), particularly if, as in this case, the solution involves significant expense.

Because of the inherent uncertainty of diagnosis, there is always the potential for missed or mistaken diagnosis in clinical practice, and clinicians must be aware of this. Some have argued that we might have more confidence in our diagnoses if clinicians more regularly used computer-based diagnostic algorithms. There are currently many diagnostic programs either available or in development, and dozens of studies have compared computer-aided diagnosis with expert diagnosis. Although some of these studies show that computer-aided diagnoses outperform expert diagnoses in certain settings (Grove 2000), at the current time, the use of such diagnostic aids in clinical practice is not widespread, and until it is, clinicians must continue to rely on more traditional methods for diagnosing their patients.

Let us suppose that the clinician in our example, given the patient history and presentation, decides to test for total IgG and finds that the IgG level is 530 mg/dL (where the normal value is 700–1600 mg/dL). What does this mean for the diagnosis? In order to answer this question, the test information needs to be used to estimate the post-test probability of CVID. In other words, in our particular example, the clinician must ask “what is the probability of CVID given a total IgG level of less than 700 and a history of frequent bacterial sinusitis?” The answer to this question in turn depends upon an evaluation of both pre- and post-test probability of the disease. This can be done informally (which is what is usually done in busy clinical practice) or formally, using Bayes’ Theorem. Bayes’ Theorem is a mathematical formula that is used to calculate post-test probabilities given pre-test probability and new evidence (such as a test result). For instance, Bayes’ Theorem can be used to determine the probability that a person who tests positive for CVID actually has the disease. Specifically, in our example, we are interested in the probability of a person having CVID (X), if he has a positive test result (+). According to Bayes’ Theorem, this probability is:

\[
Pr (X \mid +) = \frac{Pr(X) \times Pr(+ \mid X)}{Pr(+)}
\]

(This is read: The probability of X given a positive result is . . .) Let us assume that a positive test result for CVID is indicated by an IgG level of 700 or less, and that the occurrence of
the disease in the general population is .004%. Further, for the sake of illustration, let us also assume the following values, which represent features of the test itself:

- \( \Pr(\text{positive test result} \mid \text{subject has CVID}) = 96\% \)
- \( \Pr(\text{negative test result} \mid \text{subject has CVID}) = 4\% \)
- \( \Pr(\text{negative test result} \mid \text{subject does not have CVID}) = 91\% \)
- \( \Pr(\text{positive test result} \mid \text{subject does not have CVID}) = 9\% \)

First, we need to find \( \Pr(+) \). This is given by:

\[
\Pr(+) = \left[ \Pr(+ \mid X) \times \Pr(X) \right] + \left[ \Pr(+ \mid \neg X) \times \Pr(\neg X) \right]
\]

Where

- \( X \) is the occurrence of the disease in the general population,
- \(+\) is a positive test result, and
- \( \neg X \) is the probability that someone in the general population does not have CVID. Substituting in our numbers from above, we get:

\[
\Pr(+) = \left[ .96 \times .00004 \right] + \left[ .09 \times .99996 \right] = .0900348
\]

Now we can substitute the calculated value of \( \Pr(+) \) into our formulation of Bayes’ Theorem:

\[
\Pr(X \mid +) = \left[ \Pr(+) \times \Pr(X) \right] / \Pr(X) = \left[ .0900348 \times .00004 \right] / .0900348 = .0004265
\]

This result shows us that, even with a positive test result for CVID, it is very unlikely that a person randomly chosen from the general population has the disease. However, the probability that the patient in our example (given a positive test result) has CVID is not the same as the probability (calculated above) of a person in the general population (given a positive test result) having it. The diagnosis of CVID in this particular patient depends largely upon his history of frequent, recurrent bacterial infections. This information makes it far more likely that he, rather than a randomly chosen individual, has CVID. This reliance of diagnosis on history, even given positive test results, highlights the clinical and diagnostic importance of taking a careful patient history.

**Formulating a Treatment Plan**

Once a diagnosis is made, the clinician can turn her attention to formulating, together with the patient, a plan for treating the diagnosed condition. This plan must consider the cost and risks on the one hand, as well as the potential benefits of the proposed treatment on the other. In our example, the treatment, as we will see, is very high in cost but carries little risk and a high potential for patient benefit.

When it comes to treatment decisions, it is generally understood that the patient has the final decision-making authority and can choose whether to accept or reject a proposed treatment plan. However, decisional priority might lie with the clinician, the patient, or both (Whitney 2003). What this means is that, in some cases, a patient might wish to defer a treatment decision to his or her clinician. However, in many cases, patients want to participate with their clinicians in the decision-making process.

This concept of shared decision making is much discussed in current medical literature. While it is agreed that sharing the burden of decision making is best for both patients and
clinicians, exactly how this should be done in practice is debated. For instance, one might wonder whether or not patients should be given all the relevant information about various treatment options or whether instead clinicians ought to narrow down treatment choices according to their own expertise and preferences before presenting them to their patients. On the one hand, it is argued that patient autonomy depends upon completeness of information. On the other hand, it has been pointed out that patient satisfaction “has been shown to be higher when people choose from a smaller set of options” (Botti and Iyengar 2004), perhaps because too many options can seem overwhelming to a patient when he feels that he doesn’t have enough education or information to make an intelligent choice from among the options. Although patient satisfaction is not the sole goal of clinical medicine, it is nevertheless something that needs to be taken into account in medical decision making, especially in the U.S. context, and thus cannot be ignored.

Further, although accurate information must be given to a patient before he or she can make an informed decision regarding a treatment option, “precise information (e.g., about risk) is frequently ineffective in changing decisions and behaviors” because patients and professionals rely on the personally relevant meaning of the information, rather than on the information itself (Reyna 2008). In other words, it is important that patients are told what their options are, but clinicians must also allow them the opportunity to interpret these options according to their own values and preferences. Once this interpretation has taken place and been discussed, the clinician and the patient can then decide together upon a mutually agreeable course of action.

In addition to clinician and patient values and preferences, in many cases extra-patient considerations such as health justice issues might inform or influence treatment decisions. If a treatment under consideration is a scarce resource, or in some other way affects the population at large, then this factor must be taken into account before deciding to use the treatment on an individual patient.

In our example, if the patient is diagnosed with CVID, then the patient and the clinician will have to decide together how to best treat the condition. In some cases, if the infections are mild enough (that is, if they do not require, for instance, intravenous antibiotics or extended hospital visits) the clinician might suggest trying prophylactic antibiotic therapy before moving to IgG replacement. The benefit of continuous antibiotic treatment is that it is less expensive than either intravenous or subcutaneous IgG; however, there are downsides as well. First, while antibiotics might work to prevent bacterial infections such as the sinusitis this patient has been experiencing, they do not prevent viral or parasitic infections—infections that CVID patients are also predisposed to getting. Second, long-term antibiotic therapy can lead to reduced and/or changed intestinal flora, with resulting decreased immunity to certain infections: clearly not a benefit to someone who is already immune deficient. Third, long-term treatment with antibiotics can result in antibiotic-resistant organisms, which might be passed to others in the community, raising an issue of health justice.

On the other hand, IgG therapy, while not entailing the downsides of continuous antibiotic therapy, has its own risks. The most significant risks of IgG therapy are blood clots and complications due to hyperviscosity (increased blood thickness) (Katz 2007). Further, IgG treatment is both expensive and inconvenient. Intravenous IgG must be given either in an infusion center or by a home health care practitioner and takes 4 to 6 hours per infusion, one day per month. For the patient, this means a potential loss of one full workday per month, if an infusion center or home health care practitioner with weekend hours is not available. In that case, subcutaneous IgG therapy might be a better option. Although subcutaneous IgG is generally more expensive than intravenous IgG, it can be administered by the patient at home (without assistance) on a weekly basis. Infusion time for this method of delivery ranges from
1–3 hours per infusion. Some patients, however, are not willing or able to self-infuse, so this option cannot be utilized in all cases.

How Prognostic Considerations and Patient Interests Affect Treatment Decisions

After the clinician arrives at a diagnosis in a patient case, then decisions regarding treatment must be made. These decisions must take into account both prognostic considerations and patient interests. After diagnosis, the first question a patient often asks is, “What’s going to happen to me?” (Mebius, Kennedy, and Howick forthcoming). A prognosis helps to answer this question. However, accurate prognoses are notoriously difficult to make, and the reliability of available prognostic tests is currently very limited. Recently, it has been suggested that, as with diagnosis, computer-aided prognosis might be able to remedy this situation by improving prognostic reasoning and data acquisition. There are a growing number of trials comparing clinical reasoning aided by real-time, computer-based decision and action algorithms with expert decision-making alone. The results from these trials so far suggest that computer aids may improve treatment decisions based on prognostic considerations in certain health care settings, such as trauma care (Matheny et al. 2005, Ahmed et al. 2009, Fitzgerald et al. 2011), and these aids might be more widely available for clinical use in the near future.

Until such time, however, clinicians must rely on published data of prognostic studies in order to improve treatment decisions. While the gold standard for testing the efficacy of medical treatments is the randomized controlled trial, in the case of prognosis, observational (particularly cohort) studies are considered to be superior for providing prognostic evidence and answering prognostic questions (Greenhalgh 2014). Observational studies allow for a longer follow-up period, which is useful for many types of prognostic information. However, many worry that observational studies do not provide internally consistent evidence (Howick 2011) and are more prone to bias than randomized controlled trials. Because of this, some clinicians are skeptical about the reliability of information gained from observational prognostic studies and tend to make treatment decisions without taking these studies into account.

Let us turn again to our example to see how the consideration of prognosis affects treatment decision in clinical practice. Suppose that the clinician and patient are considering whether to start treatment with weekly subcutaneous infusions of IgG as a treatment for the patient’s CVID. They might want to know what the prognosis for a 32-year-old male patient with CVID would be, given this treatment, before deciding to start the infusions.

However, this prognostic question is difficult to answer for several reasons. First, “high-quality controlled trial data on the therapy [. . .] is generally lacking” (Wood et al. 2007). While we do know that higher doses of immunoglobulin are associated with reduced infection frequency and a decreased risk of a variety of organ-specific complications and malignant cancers that can occur with un- or under-treated CVID, no long-term clinical data is available on exactly how IgG dose affects these risks. Further, while some patients find that their rate of infection decreases dramatically with IgG therapy, others find that the number of their infections remains the same, but that they recover more quickly from each infection. Also, patients with CVID are more likely than the general population to have autoimmune and endocrine disorders, and these conditions can complicate, or in some cases even hinder, the treatment of the concomitant diseases. For example, IgG therapy, since it is composed mainly of proteins, can bind certain protein-bound medications in the blood, such as levothyroxine, which is often given for hypothyroidism, a condition that commonly occurs in conjunction with CVID.

Despite the lack of high-quality prognostic evidence, it is likely, based upon observational and case studies, that the patient will have a better prognosis when given the treatment, than
he would have if he remained untreated. In our example, then, the clinician can be confident in advising her patient that his health will improve with the proposed treatment for his condition, even in the absence of sufficient clinical trial data that supports this prognosis.

**Conclusion**

As can be seen from the analysis of the preceding example, even in patient cases that might initially appear to be relatively uncomplicated, the process of medical decision making can be very complex, and in all instances, involves considerations of epistemology (such as how to understand diagnostic information), ethics (such as consideration of patient values and preferences, or of how much information to give to a patient), probability (such as, for instance, when interpreting diagnostic test results or making prognostic estimations), economics, and health justice. Thus, learning to make medical decisions requires at least a basic understanding of concepts in each of these fields and careful consideration on the part of both the clinician and the patient.

**Note**

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**References**


Further Reading