

Why and How Healthcare Decisions Are Made

After studying the chapter, readers will be able to:

- Appreciate and understand the importance of decision-making in healthcare settings.
- Identify scenarios in which optimal decisions are feasible.
- Formulate approaches to synthesize a complex situation into several simple components and seek optimal decisions for each situation.
- Integrate several optimal decisions into an overall decision policy.
- Interpret the concepts and methodologies to attain healthcare decisions.
- Train in and practice both the concepts and the methods in other healthcare settings.

1.1 Motivation

What is a decision? A *decision* is the process of selecting one option over others for the sake of some advantages. The advantages might be a minimal use of time or human resources, or constrained and/or gained profits. When no alternative appears that is better than the chosen decision in any sense, that decision is called the *optimal decision*. Attaining the optimum decision is not quite trivial at times due to the complexity of reality. The *decision maker* is often in need of technical experts called *analysts* who can simplify, organize, and make the decision easier for the decision maker. Decision-making is a cooperative effort to reach the optimal decision. When these joint efforts succeed, the decision maker and the analyst are appreciated and applauded. When the decision results in failure with a measurable loss, the decision maker is blamed. The decision maker therefore undertakes full responsibility for directing the decision-making process. The analyst's role in the process, however, is not to be minimized or ignored.

What makes healthcare decision-making hard? It requires decision makers to think about the interests of various groups as well as to consider only limited information and resources. There are four sources of difficulty.

First, a decision is hard simply because of its complexity – the different possible courses of action and so on. Simply remembering them all is nearly impossible. Why not synthesize the complex problem into a structure that can be easily analyzed and decided in parts: the possible outcomes, the probability of those outcomes, their and eventual consequences (e.g., costs or benefits)? Structuring tools could include decision trees or influence diagrams. Second, a healthcare decision is difficult because of the uncertainty with respect to the outcomes. Third, a healthcare decision maker is focusing on multiple objectives. He or she may have to consider the trade-off of benefits in one area against costs in another. Fourth, decisions are conflicting. The involvement of different decision makers formulates diverse opinions. Some healthcare decision makers complain that the process ignores subjective opinions.

Decision-making is an iterative process with several steps. The steps are learning the scenario, identifying the aims, viewing the viable options, assigning values to the outcomes, formulating a model to capture different scenarios, quantifying the uncertainty, choosing from the alternatives, measuring the outcomes, performing a sensitivity analysis, and writing a report for future occasions. See Ozcan (2005) for types of quantitative data that are helpful to make healthcare decisions.

Making decisions is a fundamental part of both our personal and our professional lives. The problem in professional settings might differ from that in personal settings. Nevertheless, the principles and strategies we adopt when seeking the optimal decision are parallel, if not identical. Personal decision-making cannot be addressed in this book, but decision-making in professional life follows a pattern and offers a promising scope.

Is there a history of decision-making by chief executive officers (CEOs)? The answer is affirmative (see Goodwin and Wright, 2004). DuPont's nuclear plants seeking to avoid a Chernobyl-like disaster, ICI America, Phillips Petroleum, the US military, ATM Limited, and Massachusetts General Hospital School are examples of enterprises that have benefited from a disciplined decision-making process. This book

exposes basic concepts and analytical tools with illustrations from healthcare settings. The ultimate beneficiaries will be patients and their loved ones in addition to physicians, laboratory researchers, nurses, allied staff, professors who teach/train future professional graduate students in healthcare professions, health insurance agents, healthcare administrators, and healthcare policy makers in government, among others.

As much as decision-making opens opportunities to be innovative in order to resolve issues, to rectify past mistakes, and to promote new ideas with rewards for the betterment of patients, there are limitations to any decision, including the optimal one. When the background shifts with significant changes in available resources and/or the required productivity/services, the decision may fall short of optimality. A thorough description of such possibilities is called *sensitivity analysis* and is discussed in detail later in this volume.

How do we really define a decision? A *decision* is the process by which one *decision maker* or *decision makers* collectively select one option over others in order to harvest some advantage. Of course, decision-making on a collective basis might undergo operational stumbles due to conflicts of personality or dogma. Later I discuss in detail how to harmonize conflict. Irrespective of whether the decision-making is by one person or a collective, the responsibilities are similar. In other words, when the decision is correct, yielding one or more benefits, the decision maker is credited with the success. When the decision goes wrong, the decision maker is blamed for the failure, sometimes even incurring penalties. Such possibilities induce the decision maker to be cautious.

The decision maker is *risk-averse* (unwilling to take any risk), *risk-neutral* (willing to be centrist based on how others in the field have behaved), or *risk-taking* (quite amenable to implementing risky options). Psychologists and portfolio analysts in the healthcare field contend that a risk-taker might hit a jackpot if his or her decision happens to be the best. If the risk-taker's decision happens to be wrong, it may bring costly or disastrous consequences. A risk-neutral decision-maker might receive modest benefits when his or her decision happens to be correct but experience a modest loss when it happens to be wrong. There might be up or down fluctuation in the benefits/losses due to the risk-neutral decision maker's action, but the consequences would be bearable. On the contrary, the decision by the risk-averse decision maker results in a small number of benefits when it is a correct decision and a small amount of loss when it is a wrong decision. There is no exciting up or depressing down from the risk-averse decision maker's action. Such variation dictates that we ought to learn more about risk, and that is covered later in this book.

Until then, we need to understand the problem and resolve it to its optimal solution if that is feasible. At times, such an exercise might not be trivial due to technical difficulties and/or constraints. In healthcare sectors, one might consider more than one attribute, a composite model of the attributes, or knowledge building to reach the best decision at every stage in the decision-making process. New data are gathered at some point in time. With the evidence provided in the recently gathered data, the existing *prior* opinion is updated to a *posterior* opinion via the *Bayesian conquer-and-rule principle*.

Thomas Bayes (1702–1761) was a British mathematician with probability and philosophy orientations who came up with the idea that new evidence can moderate and update even an improper, less accurate prior opinion to a proper, more accurate posterior opinion. This continuous, time-oriented process of updating was controversial due to opposition from physics experts who argued that time is not a random entity. This process was not well received until statisticians accepted it and promoted it as natural and scientific. Bayesian thinking reappears later in several chapters in this book.

To ease the challenges faced by the decision maker, he or she has no choice other than to appoint one or more analysts depending on the fields to be covered. The fields might range from finance, uncertainty, subsequent decisions, conflict management, adversities, risks, evaluating current programs versus creating new ones, operational efficiency, quality in service, wait time, scheduling, reviewing techniques, storage, and simulations, to time series data analytics. Neither the decision maker nor any one analyst is going to have mastered all of these, necessitating a team of several analysts. Natural by-products of multiple analysts could result in conflict, disagreement, and chaos. This creates a need to harmonize, and the strategies for doing so are addressed in Chapter 8 on group decision-making. In healthcare, the prevalence of illness, treatment types, and regulations on medical services periodically change. Consequently, the administration of healthcare services is subject to a dynamic process that transforms into a complex operation requiring judicious decision-making. Hence, data-guided decision-making (the focus of this book) makes more sense.

1.2 Concepts

To facilitate understanding, appreciating, and applying the needed concepts and methods, an appropriate sequence is followed in this book. In this chapter, motivations for data-guided decision-making are exposed so as to set the stage for grasping the importance of decision-making based on evidence.

Chapter 2 articulates the benefits of making decisions founded on data. To acquire the skill of using Microsoft Excel (which almost everyone has via Microsoft Office), the freely available Microsoft Math Solver, and the statistical software JASP, tutorials with illustrations are included in Chapter 3.

Chapter 4 addresses the fact that, in the current, technologically advanced age of web pages and information flow, healthcare decision makers need exposure to authentic data sources and sampling methods. Chapter 4 also emphasizes the principle of data orthogonality, which the statistics community exercises in its procurement of data.

Uncertainties in healthcare settings (whether referring to small clinics, medium or large hospitals, supportive establishments like pharmacies, health insurance providers, emergency ambulance services, etc.) are recognized by healthcare administrators and researchers, but they sometimes do not involve such uncertainties in their decision-making. This state of affairs reflects too many technicalities in probability concepts. To ease the decision maker's feeling of insufficiency, Chapter 5 presents basic concepts, methods, and interpretations based on real-life examples.

Chapter 6 builds on the uncertainty principles examined in Chapter 5 to describe the implications of coding and basing values for establishing priorities. The chapter also explains how statistical models sharpen decision-making in healthcare. Though the details of composing a value system are thoroughly described later in this book, the value system created by the decision maker is indicative of his or her preferences. The analyst can therefore use that value system so as to be more efficient in providing pertinent information to the decision maker. The value system is an integral part of a larger concept called a model. What is a model? A model is an abstraction of reality. A well-known statistician, Dr. George E. P. Box (1919–2013), contended that all models are wrong, but some are useful. Per his definition, models are presented with illustrations in Chapter 6.

Often in healthcare settings, decisions are made sequentially by patients and service providers. The decisions are connected and interdependent. Their outcome is random, captured, and measurable and sometimes results in a setback (a loss) or a forward positive push (a gain). The loss or gain is kept in mind when making the next decision. This collection of decisions constitutes what is called a *decision tree*, described with illustrations in Chapter 7. The notions of expected value and independent or conditional probabilities featured in Chapter 5 are utilized in Chapter 7. As alluded to earlier, when a decision is made with one or more analysts and decision makers, conflict is

inevitable. Chapter 8 focuses on finding the optimal method to resolve these differences.

Due to a variety of shortcomings in the healthcare setting, unanticipated adversities occur, causing damage to the reputation of healthcare services and/or even the deaths of patients. Such tragedies can trigger a class-action suit against the system administrators. Decision makers need to learn about the bad consequences and how all employees can be best trained so as to avoid the occurrence (not the reporting) of adversities. Neat concepts and practical methods that can be adapted for the healthcare setting are highlighted in Chapter 9.

A major concern among patients and medical/healthcare providers (including local, state, and federal government healthcare policy makers) is that healthcare has become too costly. Almost everyone involved in healthcare seeks to maintain or even lower its cost. To attain this goal requires many efforts. For these efforts to succeed, a comprehensive understanding of cost cutting is the starting point, as outlined in Chapter 10.

No matter how scientific the healthcare researcher's decisions may be, they are vulnerable to a variety of controllable causes and unpredictable events. Decision makers must educate themselves about controllable causes but prepare to deal with unpredictable events. In this process, similarity coefficients between the proto event in the past and the index event in the current scenario might be helpful. These and other related ideas with methods and illustrations are described in Chapter 11.

Healthcare administrators need to periodically evaluate the currently available programs in terms of their cost-effectiveness, their demand, their quality, and so forth, for the sake of license renewal by accrediting agencies. They also need to seek expansion of the healthcare services they offer. Chapter 12 describes such concepts and methods that are currently practiced in the healthcare sector.

In the process of renewing licenses, raising funds, making reforms to stay competitive in the market, and working with the governing board of directors, healthcare administrators compare their own institutions with those of their competitors. When the relevant data are deterministic (precisely measurable with no interrelations among the aspects), the comparisons in an efficiency scale $[0, 1]$ among the selective units are assessed as described with illustrations in Chapter 13. When the data are stochastic (subject to random measurement errors and/or statistical interdependencies among the aspects), the comparisons are performed as presented with illustrations in Chapter 14.

Mainly due to an American-born world-famous statistician, William Edwards Deming (1900–1993), who professed, practiced, and taught the importance of

sampling techniques and statistical reasoning to identify inefficient systems, the quality of production has been enhanced in the industrial sectors. His ideas and 14 principles under the name “six sigma” garnered popularity among members of the service sectors, including those in the healthcare field. Deming’s principles with reference to healthcare operations are illustrated in Chapter 13.

1.3 Illustration

In this section, I begin with what has been done in the literature. Optimal decision-making in healthcare is narrated first. Many decision-making techniques are rolled in. Burkholder et al. (2020) recommend mandating counselor competency in using ethical and decision-making models. Based on a random sample of 245 students, passages describing a thyroid scan, and basic healthcare insurance information, Dolezel et al. (2020) establish that age is related to healthcare literacy, healthcare work experience, and healthcare credentials. However, these demographic disparities are not well understood. Galetsi et al. (2020) reveal that clinicians, healthcare providers, policy makers, and patients are experiencing exciting opportunities due to big-data analytics. Greenberg et al. (2020) highlight the difficulties healthcare providers faced in making healthcare decisions during the global COVID-19 pandemic. Those hard decisions included assigning limited resources to equally needy patients, balancing their own physical and mental healthcare needs with those of patients, and providing care for all severely unwell patients with constrained resources.

Healthcare is a limited resource. Its rational and fair allocation requires an evidence-based decision-making analytical model. What is an analytical model? An analytical model utilizes available data from different sources, projects alternative decisions, and produces information on healthcare costs and benefits. The increasing complexity of decision-analytic methodology has raised the need for guidelines of model development. Treskova (2020) outline a framework as follows:

- Obtaining data on the topic of interest.
- Researching the knowledge base.
- Writing and programming a mathematical formulation.
- Re-parameterizing the model.
- Conducting an economic evaluation.
- Analyzing uncertainty.
- Confirming that informed decision-making is superior.

The importance of the healthcare decision-making process cannot be overstated.

Pain management is of interest in healthcare services. Excellent pain management involves pain assessment and utilizing efficient strategies to attain less or even no pain. Educating patients on pain reduction is also a strategy. Healthcare providers must consider the use of opioids in pain reduction. In combination with opioid analgesics, non-pharmacological treatments and specific exercise regimens have proven beneficial in reducing pain. With patients who present with a history of opioid abuse, treatment choices should focus on beneficence, non-maleficence, advocacy, patient autonomy, nurse autonomy, and veracity. *Non-maleficence* means not inflicting harm or pain. *Advocacy* is an act or process of supporting a cause or proposal. When a nurse identifies a potentially harmful situation regarding the use of opioid analgesics, healthcare professionals can educate the patient by suggesting lower-level opioid doses or non-opioid interventions. *Patient autonomy* refers to patients’ freedom of choice. To promote cooperation and satisfaction in pain management, nurses ensure patient involvement. *Nurse autonomy* denotes nurses’ obligation to provide accurate information to their patients regarding the pain regimen, including side effects, risks and benefits, and non-pharmacological treatment options. The information should be conveyed to the patient without bias or judgment. Though nurses may disagree with the pain management regimen or believe clinical findings do not correlate with the patient’s stated pain intensity, patient autonomy is not appreciated if nurses make healthcare decisions for the patient. *Veracity* refers to openness and honesty. Nurses operate under an ethical obligation to demonstrate veracity regarding ordered medications, their side effects, and healthcare discussions affecting the provider. Ethical pain management requires a fair approach and attention to patients’ physiological condition, potential treatment outcomes, and personal bias. Opioid-related inpatient hospitalizations continue to rise in the United States. Refer to Sturdivant et al. (2020) for a discussion.

A concept called *surrogate decision-making* is also worth consideration. Surrogacy in this instance refers to the involvement of relatives. Parents need to be informed and empowered to select alternate surrogates, or healthcare proxies. A variety of reasons exist why patients cannot make legal decisions for themselves: they are unconscious, they have severe cognitive disabilities, or they are minors. The need for surrogates raises several questions, including who should speak for the patient (authority) and what principle should lead them (guidance). The surrogate is expected to be guided by a living will, if one has been completed, and substituted judgment is selected. In pediatric healthcare, the biological parents are the presumptive

decision makers and legally authorized representatives for their children unless they relinquish their rights or have their rights terminated. When the parents are not reachable, they can select extended family members or close friends. Sometimes, court-appointed guardians make healthcare decisions. An employee of the healthcare-providing organization cannot serve as the surrogate healthcare decision maker. For further discussion, refer to Fishman et al. (2020).

A novel concept called *decision fatigue* encompasses self-regulatory, cognitive, and physiological fatigue. Decision fatigue is a widespread phenomenon in healthcare decision-making. Consult Pignatiello et al. (2020) for more details. Shang et al. (2020) promote the importance of healthcare decisions for patients moving between the hospital and the community. Infection prevention is a high priority in home healthcare decision-making.

A complexity arises due to the availability of big data in healthcare settings. It raises the need for artificial intelligence (AI). Several types of AI are helpful to healthcare providers. In their practice, diagnosis and treatment recommendations, patient engagement and adherence, and administrative activities are vital. There are many instances in which AI outperforms humans. Refer to Davenport and Kolakota (2019) for an appraisal. Lysaght et al. (2019) articulate how AI transforms healthcare decision-making to encompass accountability and transparency. Of course, a concern about AI exists with respect to balancing clinical practice ethically and responsibly. Avi et al. (2019) identify three different, strictly interconnected facets that need to be considered. The first facet is sociopsychological and considers the imperfections of human nature and its connected instincts, behaviors, and problems.

The second facet shows how mathematics tries to resolve problems by proposing different models and theories, each with a different level of “denaturation” from reality. The last facet is the weighted mean between the first two, and it results in a series of instruments tailored to each peculiar managerial problem. The use of information technology is emphasized in this facet so as to create a smart healthcare setting accommodating the Internet of Things, big data, and cloud computing besides AI. This information technology aims to transform the traditional medical system. This concept is evaluated in order to explain the consequences of these model changes (from disease-centered to patient-centered care), changes in informatization construction (from clinical informatization to regional medical informatization), changes in medical management (from general management to personalized management), and changes in prevention and treatment (from focusing on disease treatment to

focusing on preventive healthcare). Refer to Tian et al. (2019) for a list of advantages and disadvantages.

Machine-learning techniques employed for decades are now expanding into healthcare (Ahmad et al., 2018). Clinical providers, healthcare decision makers, and their interpretation of this model prioritize implementation and utilization. As machine-learning applications are increasingly popular and more deeply integrated into the patient care continuum, prediction is imperative.

FitzGerald and Hurst (2017) stress the importance of correcting physicians’ personal bias in diagnosis and treatment selection. Hawk et al. (2017) illustrate the need for harm reduction without necessarily extinguishing problematic health behaviors completely. They cover drug and tobacco use, syringe exchange, risky behaviors in sex work, and eating disorders. These and other healthcare professionals outline the following six principles for harm reduction: humanism, pragmatism, individualism, autonomy, incrementalism, and accountability without termination.

Brabers et al. (2017) illustrate health literacy, referring to the personal characteristics and social resources people need in order to understand and use information to make healthcare decisions. Hawley and Morris (2017) discuss the importance of awareness of cultural differences in healthcare decision-making. Innovative and sustained efforts are needed to educate and train care providers to communicate effectively and provide culturally competent healthcare.

Surgeons’ intraoperative decision-making is also a key factor in clinical practice. The four strategies surgeons can use are intuitive (recognition-primed), rule-based, option comparison, and creative decision-making. Refer to Flin et al. (2007) for details.

Arvai et al. (2004) articulate ways and means of making environmental decisions with respect to healthcare. Davenport (2009) provides a list of four steps: identifying and prioritizing the decisions that must be made; examining the factors involved in each; designing roles, processes, systems, and behavior to improve decisions; and institutionalizing the new approach through training, refined data analysis, and outcome assessment. To help patients perfect shared healthcare decision-making, Elwyn et al. (2001) mention the importance of required skills and technical knowledge.

Last, there is a subtle difference between a healthcare decision and a reached conclusion, as explained eloquently by Tukey (1960). The conclusion stands firm beside the decision in scientific inference making. Like in any human endeavor, science progresses through a build-up of knowledge. A conclusion is established with careful regard to the evidence, but without regard to the consequences of specific actions in specific circumstances. Conclusions are

withheld until adequate data have been accumulated. Both the decision and the conclusion are required in healthcare endeavors. The healthcare decision is built upon pure and applied science.

The decision-making process varies across contexts. In psychology, decision-making refers to a cognitive process. In a healthcare setting, it describes a reasoning process based on assumptions, values given to the potential outcomes, preferences narrated by management, experts' data, and the decision maker's preferences. Nevertheless, decision-making is a problem-solving operando within the available resources and time. What is problem-solving? When performance deviates from routine standards, that is considered a problem. Identification of the problem is the initial step to solving it.

More often than not, problems can be traced to changes in distinctive features of the system. Probing will reveal what has been and what has not been affected by a root cause. Some root causes can be pinpointed from the data. The so-called Occam's principle (attributed to English philosopher William Ockham) – a law of parsimony advocating the necessity of simplest explanation – is applied.

During this process, the decision maker might encounter *analysis paralysis*, a state of indecision. A major cause is the overwhelming flood of data characterized as *information overload*. Speier et al. (1999) define information overload as when input exceeds processing capacity. Experts suggest three types of analysis paralysis – *repetitive confusing information*, *seeking additional information rather than deciding*, and *uncertainty*. Each type leads to *extinction by instinct*, making a careless decision without any systemic planning. A remedy in this state requires implementing a structural system.

Negotiation is a branch of decision-making. What is negotiation? It is a collaborative way of making an optimal decision that seeks to avoid conflict and to agree on matters of interest so as to maximize mutual benefits. Negotiation differs from coercion. Mediation is a special form of negotiation that includes a third party. When the conflicting parties accept the option given to them by the third party, it is called arbitration. Negotiation becomes distributive when one of the conflicting parties gains an amount while the other party incurs the loss. To make negotiation successful, the following strategies might help. One should be open-minded to the opponent's view. The parties should listen to each other's perceptions. Each party should seek opportunities to act consistently with the opposing party. Both sides should actively listen, articulate a purpose, and consider face-saving options. An integrated rather than an integrative negotiation is a wise approach. Negotiators often have strong instincts to win by compromising. They are at times soft and at other times hard, but they are

principled always. Some negotiators apply tactics. Barriers to successful negotiation include die-hard bargaining, lack of trust, informational vacuums, the negotiator's dilemma, structural impediments, negative attitude, disordered communication, and lack of dialogue. Emotions can be constructive or destructive, so negotiators should be rational. Negative emotions include anger, pride, guilt, regret, worry, and disappointment. Positive emotions include explicitness and patience.

In the medical profession, decision-making involves evaluating diagnostic test results so as to select one treatment over others. In dealing with the natural world, decision-making competes with time pressure, ambiguities, and high stakes. When no one choice yields more benefits, the selected choice is declared the optimal solution.

No matter who makes a decision or in what scenario, the decision needs to be ethical. What is ethics? It is a philosophical and behavior-oriented judgment to distinguish right from wrong. Ethics seeks to resolve issues triggered by wrong choices. There are three subdivisions of ethics – *meta ethics*, *normative ethics*, and *applied ethics*.

Data-based decision-making provides a remedy for all of these issues. This approach requires high-quality data and statistical knowledge. Participative decision-making might be the best approach because of its inclusive nature. Participative decision-making suits the healthcare setting as it involves multidisciplinary stockholders, commitment to patients' welfare, client-provider relations, service satisfaction, hospitals' performance, and hospitals' financial strength.

Participative decision-making does present some disadvantages, however. One of them is that inclusiveness is not genuine. Time can be an issue and concerns about inefficiency, indecisiveness, or incompetence may go unheard. Knowledge, empowerment, and experts' suggestions may not be sufficient. The provided information, communication, and mediation might be insufficient for participatory decision-making to succeed. There is no database in favor of or against participatory decision-making. A democratic operation is needed, encouraging communication. A consensus is also needed, and reaching it is not easy. Recruiting experts to assist the decision maker is costly and time-consuming. Issues can arise due to work conflicts among the participants, lower level of influence, short-term or informal participation, insubordination, or lack of policy on representative participation, among others.

1.4 Summary

Decision-making is an art. Mastering it or applying it in a particular situation relies on intelligence and/or skill level. The presentation in this book is intended to be

thought-provoking. I believe in a philosophy of listening or reading less, but thinking more outside the prescriptive norms so as to be creative and innovative. In my humble opinion, that approach has been instrumental in breakthroughs in humanity, science, art, culture, and even in life itself. See Chattamvelli and Shanmugam (2020, 2021) for a list of discrete and continuous probability distributions over the domain of possible values. See Goodwin and Wright (2004), Gray (2009), Marchau, Walker, Bloemen, and Popper (2019), and Panesar (2019) for decision-making steps.

1.5 Exercises

1. Define the concept called machine learning and describe its role in healthcare decision-making.
2. What are the technical difficulties in making better decisions with respect to poor environment and unhealthy living? Articulate strategies to overcome them.
3. Match Avi et al.'s (2019) three facets in the healthcare setting.
4. What is self-reported patient involvement in a healthcare setting?
5. Articulate the role of health literacy in healthcare decision-making.
6. Compare and contrast the ethical model and the decision-making model.
7. What different types of decision-making arise in the healthcare setting? Give some examples with data.
8. Define and comment on the vital role big data analytics play in healthcare.
9. Select a case study of the healthcare manager of a hospital and articulate his or her responsibilities, challenges in making decisions, and sources of information that might ease the process.
10. Articulate a participatory decision-making scenario in healthcare operations.
11. Identify two variables whose values are measured in a healthcare study. What are their potential values?
12. Suggest a probability distribution for the variables identified in Question 11. Are they discrete probability distributions or continuous probability distributions? Why?
13. Elaborate on why AI does a better job than humans in healthcare settings. Is it true AI can make better decision than humans? If so, give some examples.
14. Give and articulate specific examples for each one of Hawk et al.'s (2017) six principles: humanism, pragmatism, individualism, autonomy, incrementalism, and accountability without termination in a healthcare setting.
15. Narrate real-life scenarios of effective communication by caregivers to provide culturally competent healthcare.
16. Narrate an example of a good healthcare decision in the face of some uncertainty. Give an example of a poor healthcare decision whose outcome was lucky.
17. How is the concept of modeling involved in healthcare decision-making? What role do subjective judgments play in this process?
18. Illustrate a scenario in which a healthcare decision is complicated because of difficult preferences, trade-offs, and uncertainties.
19. Some believe crime would decrease if drugs were legalized. How would you proceed to investigate this? Describe a decision-theoretic point of view.
20. Narrate the importance of negotiations in the offering of a healthcare service in a hospital.

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