

More than the Mona Lisa: what Leonardo da Vinci can teach physicians

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Abstract

Leonardo da Vinci (1452 -1519) is renowned as the artist of celebrated paintings, such as the Mona Lisa and The Last Supper. He is not as well known for his contributions to science, but it is here that his ingenuity is highlighted. Many of Da Vinci's attributes made him an innovative scientist whose work continues to be relevant to physicians today.

Keywords: leonardo da vinci, desirable physician traits, art and medicine

Introduction

Da Vinci was one of the greatest minds of the Renaissance period¹; he was a master observer, had an inquisitive mind, and merged the boundaries between art and science. Here I will discuss the importance of these traits which da Vinci embodied and how they are relevant to the practice of medicine.

The Master Observer

Da Vinci refined his observational skills in order to improve his art. Although only 15 of da Vinci's paintings exist today, he left thousands of pages of notebooks filled with observations of the world.² In one entry, he instructed, "As you go about town, constantly observe, note, and consider the circumstances and behaviour of men as they talk and quarrel, laugh, or come to blows."¹ He recorded human expression and interaction as a reference for his artwork.² In another notebook, he wrote, "Which nerve causes the eye to move so that the motion of one eye moves the other?"¹ Characterizing the mechanism of eye movement is not necessary for painting the eye itself, yet da Vinci had a deep curiosity for the human body and how it functions. One of da Vinci's most impressive feats of observation was his ability to describe that a dragonfly had four wings, and that when the front wings were raised, the bottom pair were lowered.¹ The patience required to describe such detailed movement, from solely visual observation, is what set him apart from other artists of his time. Leonardo da Vinci honed his observational skills not only to further his painting, but because he found joy in noting the intricacies of the world around him.

Just as observation was important to an artist like da Vinci, observation comprises a large part of the physician's work.³ When meeting a patient, the physi-

cian must evaluate the patient's physical characteristics, often beginning by inspecting the patient's general health. Subtle qualities such as the colour of the skin or swelling may indicate underlying pathology. Physicians also note the emotional disposition of their patients as this often can be vital to providing appropriate care for them. For example, if their patient appears anxious or confused about a diagnosis, prognosis, etc., this changes how the physician should address the patient.³ Effective observation also requires actively listening to patients, which is crucial to providing them with good care. A physician who is passionate about observation will likely be able to provide more for patients and perhaps have increased fulfillment in their work, similarly to da Vinci with his art.

Inquisitive Mind and Experimental Methods

Leonardo da Vinci amassed knowledge from many sources and disciplines, and tested theories with early experimental methods. By 1504 he had collected 40 books on works of science, 50 books on poetry and literature, ten on art and architecture, eight on religion, and three on math, showing that his quest for knowledge spanned outside of the anatomical and artistic realms.¹ Da Vinci realized that knowledge came from a relationship between experiment and theory, stating, "My intention is to consult experience first, and then with reasoning show why such experience is bound to operate in such a way."¹ In his notebooks, da Vinci also advised, "Before you make a general rule of this case, test it two or three times and observe whether the tests produce the same effects," foreshadowing principles of experimental method that would later be revisited by Francis Bacon and Isaac Newton.^{1,4}

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Da Vinci's optic studies demonstrated his use of experimental methods to explain the world. He wondered why images turn right side up after passing through the eye. He dissected bovine and human eyes, and mapped the neural pathways of vision, showing the optic chiasma.⁵ He then placed an eye "in the white of an egg", and boiled it to preserve the humour.⁵ From these studies, he accurately described the position of the uvea, cornea, and lens, and correctly concluded that the eye receives light, thus facilitating vision.^{5,6} This contradicted the prevailing theories of Plato and Galen, who characterized vision as "emanat[ing] from the eye outward..."⁶ This was not information a painter needed to know, but da Vinci was motivated by voracious curiosity, and used scientific inquiry to investigate areas of interest. Da Vinci's relentless curiosity should be inspiring to physician. He amassed knowledge not because he was obliged to, but because it fulfilled his innate drive to know the world around him and how he fit into it.

Curiosity is a driving force for scientific endeavours, including medicine, and it is integral to physician success. A survey of patients, medical school preceptors, and students found "intellectual curiosity" to be seventh on the list of desirable physician traits.⁷ Lifelong learning, driven by inquisitiveness, is emphasised in medical school as a commitment that doctors must uphold to best serve their patients.⁸ Curiosity is thought to be driven by "an undesirable state of "uncertainty" that must be relieved", with the goal to return the situation to normality.⁸ Every day, physicians interact with uncertainty in the form of complex, unique patients. Inquisitiveness helps them to ask the right questions to better patients' lives. Moreover, to treat a disease, one must know its cause. Physicians must investigate gaps in scientific knowledge with experimental reasoning, using observation to test hypotheses, as da Vinci did.

Curiosity does not only benefit physicians in academic settings, however. A good physician cares for and empathizes with patients. The action of putting oneself in another's position is an act of curiosity itself.⁹ A physician is "... curious enough to know the patients: their characters, cultures, spiritual and physical responses, hopes, past, and social surrounds."⁹ Medical students and physicians should embody da Vinci's curiosity and continue to foster curiosity throughout their practice.

Art and Science

Leonardo da Vinci merged the boundaries between art and science. This is displayed in his anatomical studies from 1508-1513.¹ An example of this intertwined relationship is his study of the heart, specifically of the aortic valve. Da Vinci was fascinated with the movement of water and studied eddies and vortices extensively.¹ There are numerous sketches of water in his notebooks, and he painted rivers and lakes in the background of works, including the Mona Lisa.¹ He also famously painted subjects with whirlpool-like ringlets.¹ When he studied the heart, da Vinci used the knowledge of eddies he had collected for painting, and hypothesized that "the blood which turns back when the

heart reopens is not that which closes the valves of the heart. This would be impossible, because... the blood that presses from above would press down and crumple the membrane."¹ To test this, da Vinci made a glass model of the heart with the aortic root, which he filled with water.¹ He then placed seeds and paper into the water to visualize its flow.¹ His final hypothesis was this: "Vortices, effecting partial reverse flow in the proximal aorta, would aid closure of the aortic valve in diastole."¹⁰ Amazingly, these observations were not confirmed until 450 years later.¹ Before then, the common belief was that the pressure from above the aortic valve alone caused it to snap closed.¹ In the 1960s, research led by Brian Bellhouse at Oxford performed an experiment strikingly similar to da Vinci's glass heart model, mapping the movement of blood with dyes and radiography. They showed that "Leonardo da Vinci correctly predicted the formation of vortices between the cusp and its sinus and appreciated that these would help close the valve."¹ In 2014, an Oxford research team used time-resolved magnetic resonance imaging (MRI) techniques to map aortic root blood flow in vivo, and determined that da Vinci's "prediction of systolic flow vortices was accurate and that he provided a strikingly precise depiction of these vortices in proportion to the aortic root."¹⁰ The comparison revealed remarkable similarities between da Vinci's artistic renderings of the vortices and the 4D MRI images.¹⁰ If da Vinci had published his anatomical works, he would have had lasting impacts on the scientific world. Unfortunately, they were never published, and much of his work would be re-discovered centuries later.¹

Da Vinci's skills and interests did not exist in isolation. His curiosity led him to observe carefully, which developed his artistic skills. His artistic talent allowed him to uniquely explore ideas, such as parallels between eddies in a stream and blood moving through a human heart. He took information from different areas of study, such as the movement of water or human anatomy, and merged them together masterfully in his paintings. Similarly, doctors are tasked with merging science with art. Physicians must have a solid foundation of knowledge and keep up to date with new information and technologies.¹¹ But medicine is also an interpersonal profession in which physicians must master the art of working with complex patients and ailments. The art and science of medicine are intertwined; "Taking the patient's history is as much art as science; treatment is pastoral care as well as pharmacological rationality."¹² Doctors must be familiar with the art of maximizing patient welfare, being compassionate, trustworthy, and advocating for patients.¹¹

Conclusion

Da Vinci modeled the relationship between art and science. He used his knowledge of water eddies from painting and applied it to his aortic valve studies. Physicians similarly must use their medical knowledge and apply it to individual patients, while providing compassionate care.¹² Da Vinci also demonstrated traits desirable in a physician: Firstly, he was a master observer, and

challenged himself to observe in order to advance his art. Similarly, physicians must observe the physical and emotional state of the patient in order to provide patient-centered care. Secondly, da Vinci had insatiable curiosity, and developed rudimentary scientific methods to investigate his questions. Physicians must be curious how to provide the best care for their patients and use scientific methods to prove their hypotheses. By being curious about the patients themselves, physicians can foster a genuine relationship between physician and patient.⁹ A physician, driven by curiosity, will listen carefully, observe, and utilize scientific knowledge to fortify the art of healing. Leonardo da Vinci demonstrated these qualities throughout his life, making him an appropriate role model for physicians today.

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