National Journal of Advanced Research
www.thestudiesjournal.com
ISSN: 2455-216X
Received: 30-09-2025, Accepted: 30-10-2025, Published: 14-11-2025
Volume 11, Issue 2, 2025, Page No. 33-39

Medical transformation and the reconstruction of health concepts in the nineteenth century

Dr. Lung-Tan Lu
Department of Management, Fo Guang University, Taiwan

Abstract
The nineteenth century marked a pivotal turning point in the history of medicine. Emerging from Enlightenment rationalism, medical understanding underwent a fundamental epistemological restructuring—shifting from an organ-centric framework to a cellular-level paradigm—thereby redefining health from a "machine-repair" model to a "system-governance" concept. Employing historical document analysis, this study examines how Enlightenment rationalism laid the theoretical groundwork for pathological anatomy, how microscopic technology facilitated the birth of cell theory, and how Rudolf Virchow's "body-as-nation" metaphor reshaped the logic of defining health and disease. The research argues that the nineteenth-century medical revolution not only achieved technical breakthroughs in pathology and cytology but also realized an intellectual advancement from vague holism to sophisticated systems theory in the philosophy of health. Its core achievement lies in establishing "cellular order" as the theoretical prototype of "health order," laying the ideological foundation for the principles of "prevention first" and "holistic governance" in modern health management. Furthermore, this transformation restructured the roles of physicians and patients: physicians evolved from passive repairers to "governors of life systems," while patients became "self-managers" responsible for maintaining their own cellular order.

Keywords: Holistic health, integrative medicine, digital health, mental health, history of health thought, medicine history

Introduction

Since Hippocrates proposed the humoral theory, Western medical understanding of health and disease had long remained at a macro-holistic level. Disease was attributed to supernatural forces or humoral imbalance, and treatment relied on empirical interventions. This cognitive paradigm began to loosen during the Enlightenment in the eighteenth century and was thoroughly shattered by the medical transformation of the nineteenth century. Breakthroughs in microscope technology revealed the cell as the basic unit of life, the establishment of cell theory shifted medical research from organ anatomy to cellular pathology, and Virchow's body-nation metaphor further reconstructed the definitions of health and disease (French, 2003) [6]. Existing scholarship has predominantly focused on the technical history of nineteenth-century medicine (e.g., microscope improvement, biological contributions of cell theory) or isolated analyses of individual scholars' theories (e.g., Virchow's cellular pathology). However, few studies have integrated the intrinsic logic of this transformation from the perspective of the intellectual history of health: How did Enlightenment rationalism pave the way for cellular exploration? How were technical breakthroughs translated into a cognitive revolution? And how did cellular-level understanding reshape the core concepts of health management? This study seeks to address this gap by tracing the cognitive evolution of nineteenth-century medicine from organs to cells, analyzing the process of reconstructing the definition of health, and revealing its intellectual legacy for modern health management.

This study adopts historical document analysis, drawing on core literature including: Enlightenment medical rationalist works (e.g., Descartes' Discourse on the Method, La Mettrie's Man a Machine); classic texts of pathological anatomy (Morgagni's De Sedibus et Causis Morborum); foundational documents of cell theory (Schleiden's Beiträge zur Phytogenesis, Schwann's Mikroskopische Untersuchungen); authoritative works on cellular pathology (Virchow's Die Cellularpathologie); and modern scholarship on medical history and health management (e.g., Harrington, 2008; Marmot, 2015) [8, 11]. Beyond tracing the evolution of technologies and theories, this study emphasizes how these changes transformed human understanding of the essence of health, providing a historical reference for contemporary health management.

The Medical Legacy of the Enlightenment (Eighteenth Century)

The cellular cognitive revolution of the nineteenth century was not accidental but an inevitable continuation of the rationalist legacy of the eighteenth-century Enlightenment. Centered on reason, the Enlightenment rejected supernatural explanations and blind tradition, advocating the exploration of natural laws through observation, experiment, and logical reasoning. This spirit profoundly reshaped the paradigm of medical research, laying a macro foundation for subsequent cellular-level exploration. Prior to the eighteenth century, the dominant theory in Western medicine was the humoral theory proposed by the ancient Greek physician Hippocrates, which posited that human health depended on the balance of four humors—blood, phlegm, yellow bile, and black bile—and that disease resulted from humoral imbalance (Nutton, 2013) [15]. During the Middle Ages, religious thought further attributed disease to divine punishment or demonic possession, and medical practice was a mixture of religious rituals and empirical remedies, lacking an empirical basis.

The Enlightenment shattered this cognitive framework. In Discourse on the Method (1637), René Descartes proposed the metaphor of the body as a machine, conceptualizing the human body as a sophisticated mechanical system composed of parts such as bones, muscles, and internal organs—the heart as a pump, the lungs as bellows, and joints as levers—with disease understood as mechanical breakdown (Descartes, 1637/1998) [4]. This metaphor completely stripped medicine of its supernatural overtones, integrating it into the realm of rational analysis: the physician's role was no longer to harmonize humors or pray to deities but to diagnose faulty parts and repair mechanical defects like an engineer. Julien Offray de La Mettrie further developed this idea in Man a Machine (1748), explicitly arguing that humans are essentially machines, driven solely by mechanical motion without any mysterious forces (La Mettrie, 1748/1996) [9]. Although this extreme rationalist view sparked controversy, it strengthened the notion that the body could be studied through empirical methods, paving the way for medicine's transition from philosophical speculation to experimental science. The Enlightenment's greatest contribution to medicine was the systematic development of pathological anatomy, marking medicine's true entry into the empirical era. Prior to this, physicians could observe disease symptoms but could not directly link them to organ lesions. Pathological anatomy, however, established the concept of the lesion—the essence of disease as localized damage to specific organs—by correlating symptoms observed during a patient's lifetime with pathological changes in organs identified through postmortem dissection (Meyer, 1990) [12].

The Italian physician Giovanni Battista Morgagni was the founder of pathological anatomy. In De Sedibus et Causis Morborum per Anatomen Indagatis (1761), based on over 700 postmortem cases, he systematically demonstrated that the causes and locations of diseases resided within organs (Morgagni, 1761/2005) [13]. For example, he observed that patients with pneumonia exhibited congestion and suppuration in the lungs, and those with edema showed structural abnormalities in the kidneys, directly linking symptoms such as cough and dyspnea to lung lesions, and edema to kidney pathology. This research fundamentally transformed the logic of disease diagnosis: physicians no longer relied solely on symptom inference but sought pathological organs through dissection, and treatment accordingly focused on repairing or removing diseased organs (e.g., appendectomy, treatment of damaged hearts). Nevertheless, Morgagni's research had limitations. While he established the relationship between organ lesions and disease, he could not explain the microscopic mechanisms underlying organ pathology. For instance, was abnormal cardiac pumping function a problem with myocardial tissue as a whole, or a failure of the smaller units composing the myocardium? Was impaired pulmonary gas exchange a defect of the lung lobes, or of a microscopic structure within the lungs? This blind spot in macro-level understanding led nineteenth-century scientists to recognize that a true comprehension of life and disease required transcending the organ level to explore the smallest unit of life—the cell (Hall, 1999) [7].

Technological Revolution and Cognitive Breakthrough: From Microscopic Observation to Cell Theory

The transformation of nineteenth-century medicine from organs to cells was essentially a classic case of cognitive revolution driven by technological breakthroughs. Leapfrog advancements in microscope technology broke the limitations of naked-eye observation, allowing humans to see cells for the first time. Meanwhile, the research of Matthias Schleiden and Theodor Schwann elevated cells from microscopic structures to the basic units of life, establishing cell theory and providing a microscopic foundation for understanding health. The discovery of cells depended on improvements in microscope technology. The resolving power of the human eye is limited to approximately 0.1 millimeters (100 micrometers), while the diameter of cells typically ranges from 10 to 100 micrometers—exactly within the blind spot of naked-eye observation (Cahan, 1989) [3]. Early microscopes (seventeenth to eighteenth centuries) had magnifications of only 20-30 times, producing blurry images with severe chromatic aberration (color distortion caused by different wavelengths of light refracting differently) and spherical aberration (image deformation). They could only observe rough structures such as insect compound eyes and plant epidermis, not the fine morphology of cells.

In the early nineteenth century, the collaboration between the German optician Carl Zeiss and the physicist Ernst Abbe completely addressed this technical bottleneck. Through optical theory calculations, Abbe proposed Abbe's theory of image formation, which stated that microscope resolution depends on the wavelength of illumination and the numerical aperture of the objective lens, rather than mere magnification. Based on this theory, Zeiss improved lens grinding techniques, adopting apochromatic lenses to eliminate chromatic aberration and achromatic lenses to correct spherical aberration (Cahan, 1989) [3]. In 1872, the two collaborated to produce a compound microscope with a magnification of up to 1,000 times, whose imaging clarity far surpassed previous equipment. For the first time, scientists could clearly observe cellular structures such as the nucleus and cytoplasm, providing a visual tool for cell research.

The rational implication of this technological breakthrough lies in its shift of medical research from the macro (organs) to the micro (cells), making humans aware that the complexity of life exists not only at the organ level but also in the tiny units composing organs. As science historian David Cahan (1989) [3] noted, the Zeiss-Abbe microscope was not merely a tool but a "cognitive window"—it made physicians realize that previous understandings of health and disease were nothing more than macro inferences akin to "the blind men and the elephant," and that the true mechanisms of life were hidden in the microscopic world.

While microscope technology enabled the discovery of cells, the research of Schleiden and Schwann integrated scattered microscopic observations into a systematic theory—cell theory—establishing the cell as the basic unit of life. As a professor at the University of Jena, the German botanist Schleiden used improved microscopes to observe plant tissues over an extended period. He first examined onion epidermis, discovering it was composed of neatly arranged, small room-like structures (what had previously been termed "cells," derived from the Latin cellula, meaning "small chamber"). Subsequently, he observed various plant tissues such as bark, leaves, and petals, finding that all plants were composed of these small units (Schleiden, 1838/1847) [20]. Prior scientists generally regarded cells as empty shells in plant epidermis with no actual function, but Schleiden proposed a revolutionary hypothesis through experiments: cells are the basic units of plant life. In Beiträge zur Phytogenesis (1838), he argued that all plants develop from cells, each containing the basic elements of life, and that plant growth, flowering, and fruiting are essentially processing of cellular division, proliferation, and differentiation (Schleiden, 1838/1847) [20]. To verify this hypothesis, he conducted a series of experiments: placing plant root tip cells in nutrient solution, he observed that cells could continuously divide and form new tissues; observing damaged leaves, he found that surrounding cells would rapidly proliferate to repair wounds. These experiments demonstrated that cells are not only structural units but also functional units of plants—without cellular activity, there is no plant life (Hall, 1999) [7].

Schleiden's discovery soon reached the German zoologist Theodor Schwann, who was researching animal digestive function at the time. Through microscopic observation, Schwann found that animal gastric mucosal cells secrete digestive enzymes, and nerve cells extend branch-like projections to transmit signals. This raised a question: Are animal tissues also composed of cells? (Schwann, 1839/1847) [21] To answer this, Schwann systematically observed animal tissues such as muscle, blood, skin, and cartilage: muscle tissue is composed of elongated spindle-shaped muscle cells, whose contraction depends on cellular relaxation and contraction; blood consists of round red blood cells (which carry oxygen) and irregular white blood cells (which perform defensive functions); skin is composed of multiple layers of flat epithelial cells, forming a protective barrier. In 1839, in Mikroskopische Untersuchungen über die Übereinstimmung in der Struktur und dem Wachstum der Tiere und Pflanzen, Schwann integrated Schleiden's research on plant cells with his own findings on animal cells, formally proposing cell theory. Its core tenets included three points: (1) All animals and plants are composed of cells; (2) The cell is the basic structural and functional unit of life; (3) New cells arise from the division of pre-existing cells (later refined by Virchow) (Schwann, 1839/1847) [21].

The academic consequence of cell theory lies in its establishment of the unity of life—whether plant or animal, simple or complex organism, the basis of life activities is the cell. Simultaneously, it completely shattered the traditional notion that life is driven by a mysterious "vital force," grounding the life sciences in materiality (Bechtel, 2006) [1]. As Schwann stated in his work, cell theory proves that life does not originate from elusive supernatural forces but from the material activities of cells—providing the only reliable foundation for medical research. While the microscope allowed humans to see cells, the development of staining techniques, physiological experiments, and microbial experiments enabled humans to understand cellular functions and pathological mechanisms, laying the groundwork for the subsequent establishment of cellular pathology.

The hematoxylin-eosin (HE) staining method invented by the German pathologist Rudolf Virchow stains cell nuclei blue and cytoplasm pink, making abnormal morphologies of diseased cells (e.g., enlarged nuclei, uneven nuclear chromatin in cancer cells) clearly distinguishable after staining (Virchow, 1858/1959) [22]. This technique provided a microscopic basis for disease diagnosis—physicians could observe cellular morphology through stained sections to determine the presence of pathology, rather than relying solely on macro symptoms. The French physiologist Claude Bernard discovered through experiments that cell survival depends on homeostasis—the constancy of the composition and temperature of extracellular fluids such as blood and tissue fluid (Bernard, 1859/1927) [2]. He also found that liver cells store glycogen (energy reserves) and kidney cells filter metabolic waste, demonstrating that different cells have distinct functional divisions, further reinforcing the recognition of cells as functional units. The French microbiologist Louis Pasteur proved through the swan-neck flask experiment that microorganisms do not arise spontaneously but reproduce from spores in the air (Pasteur, 1861) [17]. He further discovered that certain bacteria (e.g., anthrax bacilli) cause infectious diseases, proposing the germ theory of disease. This theory expanded the cognitive dimension of disease: disease is not only a result of internal cellular malfunction but may also be caused by cellular damage from external microbial invasion (Dubos, 1968) [5].

Virchow's Cellular Pathology and the Body-as-Nation Metaphor

Cell theory established the cell as the basic unit of life, but how to explain health and disease in terms of cells? In Die Cellularpathologie in ihrer Begründung auf physiologische und pathologische Gewebelehre (1858), the German pathologist Rudolf Virchow proposed the core proposition that "all disease is cellular disease" (Omnis cellula e cellula) and, through the metaphor of "the body as a nation and cells as citizens," transformed cellular-level health and disease into an understandable model of social order, thoroughly reconstructing the understanding of health (Virchow, 1858/1959) [22].

Early in his career, Virchow engaged in pathological anatomy research. He observed that the essence of all organ lesions lies in abnormalities of the cells composing those organs. For example, pulmonary congestion in pneumonia is essentially an inflammatory response of lung cells damaged by bacteria; liver sclerosis in cirrhosis is a result of fibrous tissue proliferation following hepatocyte necrosis; and elevated blood glucose in diabetes stems from the pancreas' β-cells failing to secrete sufficient insulin (Virchow, 1858/1959) [22]. Based on these observations, he explicitly argued in Cellular Pathology that the occurrence of disease does not depend on overall changes in organs or tissues but on cellular damage and abnormalities; ultimately, all disease is cellular disease (Virchow, 1858/1959, p. 54) [22].

The revolutionary nature of this proposition lies in its shift of disease understanding from macro organs to micro cells, refocusing medical research from organ repair to cellular repair. For instance, previously, physicians treating heart disease focused solely on whether cardiac pumping function was normal; Virchow, however, advocated for further analysis of whether myocardial cells were damaged, whether cellular metabolism was abnormal, and whether cellular signal transmission was impaired—arguing that only by addressing cellular-level issues could diseases be fundamentally treated. Virchow also refined the third tenet of cell theory: new cells arise from the division of pre-existing cells (Omnis cellula e cellula), rejecting the traditional view that cells form spontaneously from non-living matter. This supplement provided a key logical foundation for disease research: the uncontrolled proliferation of cancer cells is essentially dysregulated cellular division, and tissue regeneration is the orderly division of healthy cells—laying the theoretical groundwork for subsequent cancer research and regenerative medicine (Harrington, 2008) [8].

Nineteenth-century Europe was experiencing the rise of nation-states, making concepts such as nation, citizen, and social order deeply ingrained in public consciousness. Virchow ingeniously integrated this social trend with cellular understanding, proposing the metaphor of "the body as a nation and cells as citizens," transforming complex cellular activities into an understandable mechanism of social operation (Nyhan Jones, 2014) [14]. This metaphor was not merely an explanatory tool but an intellectual framework for reconstructing the definitions of health and disease. In Virchow's metaphor, the human body is a nation composed of billions of cellular citizens, and health is essentially the division of labor, collaboration, and stable social order among these cellular citizens. Different cells assume distinct social roles, collaborating through signal communication (e.g., hormones, cytokines) to maintain the normal operation of the nation (Virchow, 1858/1959) [22]:

Hepatocytes function as nutrient processing factories, converting carbohydrates from food into stored glycogen and breaking down toxic substances. Pancreatic β-cells act as resource regulators, secreting insulin to distribute glucose from the bloodstream to other cells, ensuring energy supply. Adipocytes serve as energy warehouses, storing fat when food is abundant and releasing energy during hunger to maintain the nation's energy balance. White blood cells act as the national military: neutrophils phagocytize invading bacteria, and lymphocytes produce antibodies to attack viruses. Skin cells function as border guards, arranged tightly to form a physical barrier preventing pathogen invasion. Mucosal cells secrete mucus as a moat, trapping pathogens and expelling them from the body. Fibroblasts work as construction workers, secreting collagen to build repair scaffolds when skin is damaged. Hematopoietic stem cells serve as reserve troops, continuously differentiating into red blood cells, white blood cells, and platelets to replace aging or damaged cells. Glial cells act as logistical support, providing nutrients and waste removal for nerve cells to ensure smooth signal transmission.

Virchow emphasized that health is not the absence of disease but the clear division of labor, smooth communication, and close collaboration among cellular citizens—just as a nation's stability depends on citizens fulfilling their roles and orderly social order, human health relies on the orderly activities of cells and the stability of the internal environment (Virchow, 1858/1959) [22]. This understanding thoroughly transformed the definition of health: from macro asymptomaticness to micro order, providing the theoretical origin for the "prevention first" concept in modern health management. Based on the body-as-nation metaphor, Virchow defined disease as a breakdown of social order in the cellular nation. According to the source of the breakdown, he classified diseases into three categories, corresponding to three types of national crises (Virchow, 1858/1959; Harrington, 2008) [8, 22]:

War Caused by Foreign Invasion refers to infectious diseases caused by microbial (bacterial, viral) invasion. Similar to a nation under foreign attack, microbial invasion damages cellular structures, causes cell death, and triggers war (inflammatory response). For example, Streptococcus pneumoniae invading the lungs damages lung cells and induces inflammation, manifested as fever and cough (war signals); if the defensive citizens (white blood cells) lack combat effectiveness, bacteria may spread throughout the body, leading to sepsis (national collapse). Pasteur's vaccines function like equipping the military with weapons in advance—vaccination allows immune cells to recognize pathogens beforehand, enhancing defensive capabilities (Pasteur, 1881) [18].

Functional Paralysis Caused by Citizen Dereliction of Duty refers to metabolic diseases resulting from abnormal cellular function. For example, diabetes occurs when pancreatic β-cells fail to secrete sufficient insulin—insulin acts as an energy distribution order, and its deficiency prevents glucose in the bloodstream from entering cells (cellular starvation) while causing elevated blood glucose (resource surplus). Long-term imbalance can damage vascular and nerve cells (national resource distribution chaos). Hypothyroidism arises when thyroid cells fail to secrete sufficient thyroid hormone, slowing metabolic processes in cells throughout the body (decline in national productivity), manifested as fatigue and cold intolerance (Nyhan Jones, 2014) [14]. Internal Crisis Caused by Citizen Rebellion refers to cancer resulting from abnormal cellular proliferation. Normal cells follow the cycle of growth, division, aging, and death—similar to citizens working, retiring, and passing away, maintaining the nation's population balance. Cancer cells, however, are rebellious citizens: they ignore death signals, proliferate indefinitely, plunder nutrients from other cells, and destroy surrounding tissues (rebellion expansion). For example, lung cancer cells invade normal lung tissue, impairing respiratory function; breast cancer cells can metastasize to bones and the liver through the bloodstream and lymphatic system (rebellion spread), ultimately leading to national disintegration (systemic organ failure) (Virchow, 1858/1959; Marmot, 2015) [11, 22].

The intellectual value of this metaphor lies in its transformation of abstract cellular pathology into concrete social crises, enabling physicians and the public to more intuitively understand disease mechanisms while providing a clear logic for treatment strategies—treating infections is defending against foreign enemies, managing diabetes is repairing the regulatory system, and combating cancer is quelling internal rebellion. Modern medical approaches such as chemotherapy (killing cancer cells), immunotherapy (activating immune cells), and targeted therapy (precisely attacking cancer cells) are essentially practical extensions of this metaphor (Harrington, 2008) [8].

Intellectual Insights for Modern Health Management

The transformation of nineteenth-century medicine from organs to cells was not only a breakthrough in theory and technology but also provided three core insights for modern health management: a microscopic perspective (maintaining the cellular living environment), a defensive perspective (enhancing immune cell combat effectiveness), and an early warning perspective (detecting cellular abnormalities early). Simultaneously, it promoted the transformation of physicians' roles from "organ repairers" to "biopolitical leaders," laying the foundation for the health management concepts of "prevention first" and "holistic governance." Claude Bernard's homeostasis theory and Virchow's cellular pathology collectively indicate that cellular health depends on a stable internal environment (blood, tissue fluid), and lifestyle directly determines the quality of this internal environment. The microscopic perspective in modern health management essentially involves adjusting lifestyles to provide a favorable living environment for cells (World Health Organization [WHO], 2020) [23].

Normal cellular activities require a balanced supply of proteins (structural raw materials), carbohydrates (energy fuels), and vitamins and minerals (coenzymes). Long-term high-fat, high-sugar diets disrupt the internal environment—high sugar causes blood glucose fluctuations, damaging vascular endothelial cells; high fat leads to elevated blood lipids, forming atherosclerotic plaques that impair oxygen and nutrient supply to cells. Therefore, health management emphasizes a diverse, balanced, and moderate dietary principle: daily intake of 250-400 grams of grains and tubers, 350-500 grams of fruits and vegetables, 120-200 grams of fish, poultry, meat, and eggs, and 300-500 grams of dairy and soy products. Reducing high-fat, high-sugar, and high-salt foods ensures sufficient yet not excessive cellular resources. Cellular energy metabolism relies on oxygen (aerobic respiration), with brain cells being particularly sensitive to oxygen. Regular exercise (e.g., brisk walking, jogging, swimming) promotes blood circulation, increases cardiac output, and delivers more oxygen to cells; prolonged sitting slows blood circulation, leading to cellular hypoxia and reduced metabolic efficiency (WHO, 2020). Modern health management recommends 150 minutes of moderate-intensity aerobic exercise per week plus 2-3 strength training sessions, improving cellular oxygen supply and maintaining metabolic vitality through physical activity. Toxins such as nicotine in tobacco, acetaldehyde in alcohol, and PM2.5 in air pollution directly damage cellular structures—nicotine harms lung cells, increasing lung cancer risk; PM2.5 enters the bloodstream and damages vascular endothelial cells, triggering atherosclerosis; excessive alcohol causes hepatocyte necrosis, progressing to cirrhosis (Dubos, 1968) [5]. Therefore, health management emphasizes quitting smoking, limiting alcohol consumption, and avoiding exposure to pollution. Additionally, drinking 1500-2000 milliliters of water daily promotes the excretion of metabolic waste by kidney cells, providing a clean environment for cells.

Virchow's concept of defensive citizens and Pasteur's germ theory collectively emphasize the core role of immune cells in maintaining health. The defensive perspective in modern health management essentially involves enhancing the combat effectiveness of immune cells (e.g., white blood cells, lymphocytes) through various means to resist foreign invasion (WHO, 2020).

Vaccines are attenuated or inactivated pathogen fragments. After vaccination, they stimulate immune cells to produce memory cells and antibodies—when real pathogens invade, memory cells can quickly activate, producing large amounts of antibodies to eliminate the pathogens (Pasteur, 1881) [18]. For example, COVID-19 vaccines induce lymphocytes to produce antibodies against the virus, and influenza vaccines prevent influenza virus infection. Modern health management recommends vaccination according to immunization schedules (e.g., childhood routine immunization, influenza vaccination for the elderly), enhancing immune cell defensive capabilities through pre-war training. Prolonged staying up late inhibits immune cell activity—during sleep, the body secretes growth hormone to promote cellular repair, and immune cells take the opportunity to clear damaged cells and pathogens; staying up late interrupts this process, leading to reduced white blood cell count and insufficient antibody production (Sapolsky, 2004) [19]. Health management emphasizes 7-8 hours of adequate sleep daily, providing immune cells with rest and training time through regular work and rest to maintain combat effectiveness. Chronic stress and anxiety inhibit immune function through the neuroendocrine-immune axis—stress causes the adrenal glands to secrete cortisol, and excessive cortisol suppresses lymphocyte activity and reduces antibody production (Sapolsky, 2004) [19]. For example, individuals with chronic anxiety are more prone to colds and infections because their immune cells have reduced combat effectiveness. Modern health management recommends relaxation methods such as meditation, deep breathing, and listening to music, regulating emotions to lower cortisol levels and maintain normal immune cell function.

Virchow's staining technology pioneered cellular pathological diagnosis, and modern detection technologies have further developed this concept, enabling the early detection of cellular abnormalities. The early warning perspective in modern health management essentially involves capturing early signals of order disruption through cellular-level testing, achieving early detection and intervention (Marmot, 2015) [11].

Blood routine analysis examines the quantity and morphology of red blood cells, white blood cells, and platelets, providing early indicators of cellular abnormalities—elevated white blood cells may indicate infection (foreign invasion), reduced red blood cells may suggest anemia (abnormal function of productive cells), and decreased platelets may indicate coagulation disorders (insufficient reparative cells). Health management recommends annual blood routine examinations for healthy individuals, detecting early health risks through changes in cell counts. Tumor markers are specific proteins secreted by cancer cells (e.g., carcinoembryonic antigen [CEA], alpha-fetoprotein [AFP]), which are not secreted or are secreted in extremely low amounts by normal cells. Detecting tumor markers can early indicate cancer cell activity—elevated AFP may suggest liver cancer, and increased CEA may indicate colorectal cancer (Marmot, 2015) [11]. Health management recommends regular tumor marker testing for high-risk groups (e.g., long-term smokers, individuals with a family history of cancer), combined with imaging examinations (e.g., low-dose lung CT) for early cancer detection. Cytopathological examinations (e.g., cervical smears, breast biopsies) directly observe cellular morphology under a microscope to determine abnormalities—cervical smears can detect precancerous cervical cells (e.g., cervical intraepithelial neoplasia), and breast biopsies can identify whether breast cells are cancerous (WHO, 2020). This method of directly observing cells, a modern extension of Virchow's cellular pathology, enables early diagnosis of precancerous lesions, allowing time for intervention.

Prior to the nineteenth century, physicians acted as "organ repairers"—focusing on organ lesions and repairing damaged organs through drugs or surgery. However, cell theory and the body-as-nation metaphor transformed physicians' roles into "biopolitical leaders," whose core task is to maintain cellular order, ensuring the stable operation of the cellular nation through diagnosis, treatment, and prevention (Harrington, 2008) [8].

Traditional diagnosis focused on organ symptoms (e.g., chest pain → coronary heart disease), while biopolitical diagnosis focuses on the causes of cellular disorder. For example, in patients with chest pain, physicians not only examine whether cardiac blood vessels are narrowed but also analyze whether vascular stenosis is caused by vascular endothelial cell damage or elevated inflammatory factors; in patients with recurrent colds, physicians not only determine poor immunity but also test white blood cell counts and lymphocyte activity, analyzing whether the cause is nutritional deficiency or chronic stress (Marmot, 2015) [11]. Traditional treatment focused on symptom relief (e.g., fever → reducing fever), while biopolitical treatment prioritizes restoring cellular order. For example, in patients with bacterial infections, physicians not only use antibiotics to reduce fever but also enhance immune cell combat effectiveness through nutritional support to help eliminate bacteria; in patients with diabetes, physicians not only use medications to lower blood glucose but also improve the cellular metabolic environment through dietary adjustments to promote pancreatic β-cell function recovery (early diabetes can achieve drug-free remission through lifestyle intervention); in cancer patients, physicians not only surgically remove tumors but also kill residual cancer cells through chemotherapy, activate immune cells through immunotherapy, and improve the living environment of normal cells to reduce recurrence (WHO, 2020). Biopolitical leaders emphasize prevention over treatment, constructing a firewall for cellular order through health management. This includes developing cellular maintenance plans (personalized diet and exercise programs) for healthy individuals and conducting regular cellular-level examinations; formulating risk intervention plans (earlier screening, strict lifestyle control) for high-risk groups (e.g., individuals with a family history of diabetes); and designing rehabilitation plans (nutritional support, rehabilitation exercise) for patients with chronic diseases to help cells recover function and rebuild order (Harrington, 2008) [8].

Conclusion

The transformation of nineteenth-century medicine from organs to cells represents a dimensional reduction breakthrough in the intellectual history of health, with its significance manifested in three aspects. First, the shift in cognitive paradigm: from macro holism to micro systems theory. Prior to the Enlightenment, medicine viewed health as a macro state of humoral balance; nineteenth-century cell theory redefined health as a microscopic system of cellular order—health is no longer vague asymptomaticness but measurable, intervenable orderly cellular activity; disease is no longer organ failure but cellular disorder. This transformation provided precise microscopic targets for medical research and an operable practical framework for health management. Second, the innovativeness of metaphor: the body-as-nation metaphor linked biological processes to social order, lowering cognitive barriers. The rise of nation-states in nineteenth-century Europe made the nation-citizen relationship a familiar concept among the public; Virchow's metaphor analogized cellular activity to social operation, making complex cellular functions (e.g., division of labor, defense, repair) and disease mechanisms (e.g., infection, functional abnormalities, cancer) intuitively understandable. This cross-disciplinary metaphor was not merely an explanatory tool but also shaped public health cognition—today, people still use expressions such as "immunity is the body's military" and "cancer cells are rebels" to understand health, tracing their origin to Virchow's metaphor. Third, the foundation of health management concepts: nineteenth-century cellular understanding provided the historical origin for modern "prevention first" and "holistic governance" concepts. Virchow's cellular pathology emphasized that disease originates from cellular abnormalities, suggesting that health management requires early intervention in cellular disorders; Bernard's homeostasis theory highlighted that cellular health depends on environmental stability, indicating that health management needs to adjust lifestyles to maintain the internal environment; Pasteur's germ theory emphasized defending against foreign enemies, suggesting that health management should enhance immune function. These ideas collectively constitute the core logic of modern health management—shifting from treating disease to maintaining health, and from passive response to active prevention.

This study focuses on nineteenth-century European medical history and does not address the interaction between non-Western traditional medicine (e.g., traditional Chinese medicine's qi and blood theory) and cellular understanding, nor does it explore the further expansion of cellular cognition by twentieth-century genetic technology and single-cell sequencing. Future research can be expanded in two directions: first, conducting comparative medical history research to analyze how non-Western medicine understands microscopic life units and their similarities and differences with Western cell theory; second, conducting contemporary extension research to explore how new technologies such as gene editing and cell therapy inherit and develop nineteenth-century cellular health concepts, providing new theoretical support for precision health management (Lu, 2022) [10]. The transformation of nineteenth-century medicine from organs to cells was a profound revolution in health thought. The rationalist legacy of the Enlightenment laid its macro foundation, breakthroughs in microscope technology provided its microscopic tools, the establishment of cell theory established its theoretical core, and Virchow's body-as-nation metaphor transformed it into an understandable, practical cognitive framework. This transformation not only pushed medical research to the microscopic level but also reconstructed the definition of health: health is the harmonious coexistence of cellular citizens, disease is the disruption of order in the cellular nation, and health management is the governance process of maintaining cellular order (OpenAI, 2023) [16]. Today, when we discuss cellular health, immune enhancement, and early screening, we are essentially continuing the intellectual legacy of the nineteenth century; the transformation of physicians from organ repairers to biopolitical leaders also stems from the cognitive breakthroughs of this era. Looking back at the nineteenth century, the microscope that opened the microscopic world and the metaphor of "the body as a nation and cells as citizens" were like beacons, illuminating humanity's path from treating disease to safeguarding health—reminding us that the essence of health ultimately lies in the order and harmony of tiny cells, and that each individual is a lifelong ruler of their own cellular nation. Maintaining cellular order is the fundamental way to safeguard health.

References

1. Bechtel W. Discovering cell mechanisms: The creation of modern cell biology. Cambridge University Press, 2006.

2. Bernard C. An introduction to the study of experimental medicine (Greene HC, Trans.). Macmillan, 1927. (Original work published 1859)
3. Cahan D. An institute for an empire: The Physikalisch-Technische Reichsanstalt, 1871-1918. Cambridge University Press, 1989.
4. Descartes R. Discourse on the method (Maclean I, Trans.). Oxford University Press, 1998. (Original work published 1637)
5. Dubos R. Man adapting. Yale University Press, 1968.
6. French R. Medicine before science: The business of medicine from the Middle Ages to the Enlightenment. Cambridge University Press, 2003.
7. Hall TS. A short history of biology (2nd ed.). Dover Publications, 1999. (Original work published 1964)
8. Harrington A. The cure within: A history of mind-body medicine. W. W. Norton Company, 2008.
9. La Mettrie JO de. Man, a machine (Thomson M, Trans.). Open Court Publishing, 1996. (Original work published 1748)
10. Lu L. A comprehensive healthcare model: Dimension status and approach. International Journal of Multidisciplinary Research and Analysis,2022:5(10):2597–2602.
11. Marmot M. The health gap: The challenge of an unequal world. Bloomsbury Publishing, 2015.
12. Meyer A. Medicine in the Enlightenment. Cambridge University Press, 1990.
13. Morgagni GB. The seats and causes of diseases investigated by anatomy (Alexander B, Trans.). Kessinger Publishing, 2005. (Original work published 1761)
14. Nyhan Jones L. Science and religion: A historical introduction. Routledge, 2014.
15. Nutton V. Ancient medicine (2nd ed.), 2013. (Original work published 2004)
16. OpenAI. ChatGPT (Mar 14 version) Large language model, 2023. https://chat.openai.com/chat.
17. Pasteur L. Mémoire sur les corpuscules organisés qui existent dans l’atmosphère: Examen de la doctrine des générations spontanées. Annales de Chimie et de Physique,1861:64:326–358.
18. Pasteur L. Note sur la vaccination charbonneuse. Comptes Rendus de l’Académie des Sciences,1881:92:1300–1302.
19. Sapolsky RM. Why zebras don’t get ulcers (3rd ed.). Henry Holt and Company, 2004.
20. Schleiden MJ. Contributions to phytogenesis. The Botanical Magazine,1847:5:1–22. (Original work published 1838)
21. Schwann T. Microscopical researches into the accordance in the structure and growth of animals and plants Smith H, Trans. Sydenham Society, 1847. (Original work published 1839)
22. Virchow R. Cellular pathology as based upon physiological and pathological histology Chance F, Trans. Dover Publications, 1959. Original work published 1858.
23. World Health Organization. Global strategy on digital health 2020-2025, 2020. https://www.who.int/publications/i/item/9789240019507.