PriMera Scientific Surgical
Research and Practice
Volume 5 Issue 4 April 2025
DOI: 10.56831/PSSRP-05-176
ISSN: 2836-0028

PriMera Scientific Publications

Medicine Through Ages and AI in Medicine

Type: Short Communication
Received: February 27, 2025
Published: March 25, 2025

Citation:
Jayanta Bhattacharya. "Medicine Through Ages and AI in Medicine". PriMera Scientific Surgical Research and Practice 5.4 (2025): 10-12.

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Hospital Medicine to Precision Medicine

Ackerknecht has describe "hospital medicine" quite succinctly in this way – "it was only at the hospital that the three pillars of the new medicine – physical examination, autopsy, and statistics – could be developed" [1].

Following Ackerknecht, "hospital medicine" developed in tandem with the onslaught of industrial revolution in Europe – "These were essentially a consequence of the tremendous influx of uprooted and penniless boys and girls from the country and of the beginnings of the Industrial Revolution" [2]. Such idea is substantiated by other researchers too – "The patients were poor, less articulate, less troublesome, and it was much easier to carry out research on them (especially statistically based research which required large numbers in one place – the hospital). Moreover, the advantage of the poor was that the large numbers of post-mortems that were carried out would *elicit no complaints from influential families*" [3].

The next phase in the history of medicine is assumed to be that of "laboratory medicine", as described and accepted by historians of medicine across the world. "In 1848, a new medicine, "laboratory medicine," made its appearance in Paris under the leadership of Louis Pasteur, Claude Bernard, and the Societe de Biologie" [4].

Prior to the overarching social presence of modern medicine, or what is regarded internationally as hospital medicine, Rosenberg observes, "Both physician and educated layman shared a similar view of the manner in which the body functioned, and the nature of available therapeutic modalities reinforced that view" [5]. Moreover, as Rosenberg argues, "as this world changed and provided data and procedures increasingly relevant to the world of clinical medicine, it gradually undercut that structure of cognitive framework and personal interaction which characterized therapeutics at the end of the century" [6].

What Rosenberg wanted to argue about is fairly described in an important textbook of internal medicine. It suggests that we are living in an era of "bio-medicalization" or "techno-medicine". To quote:

> The hospital is an intimidating environment for most individuals. Hospitalized patients find themselves surrounded by air jets, button, and glaring lights; invaded by tubes and wires; and beset by the numerous members of the health care team – hospitalists, specialists, nurses, nurses' aides, physician's assistants, social workers, technologists, physical therapists, medical students,

> house officers, attending and consulting physicians, and many others. They may be transported to special laboratories and imaging facilities replete with blinking lights, strange sounds, and unfamiliar personnel; they may be left unattended at times; and they may be obligated to share a room with other patients who have their own health problems. It is little wonder that patients may lose their sense of reality [7].

In such a milieu, the doctor is often the only tenuous link between the patient and the outside world and "may make a stressful situation more tolerable" [8]. S/he becomes both a scientific person and a healer. Roy MacLeod has argued that, "Medicine, in its conceptual, professional and political dimension, is both shaping and shaped by the cultural circumstances that surround it, and that give it at any time its particular character" [9]. A common culture of medicine – sustained by the image of science as the universal agent of progress, and scientific medicine as its instrument – became the hallmark of European empires throughout the world [10]. The success of western medicine was facilitated by the expansion of hospitals to the non-European world.

We have a come a long way from "hospital medicine", then "laboratory medicine" to "techno-medicine", and then to "precision medicine". Now we have entered the phase of AI-assisted medicine with new cutting edge technology and artificial intelligence.

Regarding precision medicine it is observed – "A goal of precision medicine [1] is to stratify patients in order to improve diagnosis and medical treatment. Translational investigators are bringing to bear ever greater amounts of heterogeneous clinical data and scientific information to create classification strategies that enable the matching of intervention to underlying mechanisms of disease in subgroups of patients. Ontologies are systematic representations of knowledge that can be used to integrate and analyze large amounts of heterogeneous data, allowing precise classification of a patient. In this review, we describe ontologies and their use in computational reasoning to support precise classification of patients for diagnosis, care management, and translational research" [11].

The Age of AI in Medicine

In the *Bulletin* of the American College of Surgeons it is observed that "AI is the study of algorithms that give machines the ability to solve problems, recognize words and visual aspects within images, and make predictions based on statistical inferences. When it comes to medicine, AI is able to review large amounts of data from patient records, radiological scans, or surgical videos, and use that information to detect, classify, and predict" [12].

One article in the *New England Journal of Medicine (NEJM)* has addressed the ethics of relational AI [13]. To quote at length from the article:

> November 2022 marked an inflection point in the public's experience with artificial intelligence (AI), when ChatGPT, a "large language model" (LLM), chatted with millions of people in everyday English. Previously, AI had primarily taken the form of predictive analytics that produced numerical predictions — for example, "this patient has a 68% chance of requiring intensive care within the next 24 hours". In contrast, LLMs belong to a new class of AI called generative AI (GenAI) and generate natural language, the medium in which humans communicate with each other. *GenAI is thus relational AI, which is qualitatively different from predictive AI*. Inasmuch as "the medium is the message," GenAI's relational nature raises additional ethical questions beyond the already-daunting ethics surrounding predictive AI [14].

Another article observes the issue in this way – "The interpretation of medical images — a task that lies at the heart of the radiologist's work — has involved the growing adoption of artificial intelligence (AI) applications in recent years. This article reviews progress, challenges, and opportunities in the development of radiologic AI models and their adoption in clinical practice. We discuss the functions that AI-based algorithms serve in assisting radiologists, including detection, workflow triage, and quantification, as well as the emerging trend of the use of medical-imaging AI by clinicians who are not radiologists" [15].

To conclude, we are at a threshold moment for shaping the nature of medical care in the near and distant future. The most crucial choices confronting the medical community are not technical but ethical: the paramount fiduciary responsibility is to all humans and to the persistence of medicine as a moral and human profession [16].

Foot Notes

1. Erwin H. Ackerknecht, Medicine at the Paris Hospital, 1794-1848 (Baltimore: Johns Hopkins Press (1967): 15.
2. Ibid., 15.
3. Andrew Wear. "Introduction". in Medicine in Society: Historical Essays, ed., Andrew Wear (Cambridge: Cambridge University Press (1998): 1-13.
4. Ackerknecht, idem, xiii.
5. Charles Rosenberg. "The Therapeutic Revolution: Medicine, Meaning, and Social Change in Nineteenth-Century America". Perspectives in Biology and Medicine, summer 20.4 (1977): 485-506.
6. Ibid, 497. For a nice and detailed analysis of medicine and patronage system in 18th-century England see, N. D. Jewson. "Medical knowledge and the patronage system in 18th century England". Sociology 8.3 (1974): 369-85. Jewson comments. "Perhaps the most immediately striking feature of the 18th century pathology was the general lack of agreement about the causes of illness and the effectiveness of therapies". 171.
7. Dennis L Kasper., et al. Harrison's Principles of Internal Medicine, 19th edition, vol. 1 (New York, Chicago: McGraw Hill Education (2016): 5.
8. Ibid.
9. Roy MacLeod. "Introduction". in Disease, Medicine and Empire: Perspectives on Western Medicine and the Experience of European Expansion (London, New York: Routledge (1988): 1-18.
10. Ibid, 3.
11. Melissa A Haendel, Christopher G Chute and Peter Robinson. "Classification, Ontology and Precision Medicine". N Engl J Med 379.15 (2018): 1452-1462.
12. Jim McCarttney. "AI Is Poised to "Revolutionize" Surgery". Bulletin of the American College of Surgeons (2023).
13. Ida Sim and Christine Cassel. "The Ethics of Relational AI – Expanding and Implementing the Belmont Principles". N Engl J Med 391.3 (2024): 193-196.
14. Ibid., 193.
15. Pranav Rajpurkar and Mathew P Lungren. "The Current and Future State of Interpretation of Medical Images". N Engl J Med 388 (2023): 1981-1990.
16. Ida Sim and Christine Cassel. "The Ethics of Relational AI - Expanding and Implementing the Belmont Principles". N Engl J Med 391.3 (2024): 193-196.