Power System Technology
ISSN:1000-3673

Received: 06-09-2025 Revised: 15-10-2025 Accepted: 07-11-2025

The Evolution of Medical Record-Keeping: From Paper to Digital Screen

Shuaa Ali Qaysi, Ghadah Ahmed Sharifi, Najah Mazyad Ahmed Maashi, Mona Nasser Tomeihi, Asma Muammis Ibrahim Alasiri, Ali Ahmed Qasem Asiri, Thamer Hamdan Salem Alhawiti, Khalid Muslih Jalawi Alanazi, Alaa Ahmed Mohammed Alnami, Samiha Ali Mzed Alatwe

Affiliate to Comprehensive Specialized Clinics for Security Forces in Jazan, Comprehensive Specialized Clinics for Security Forces in Tabuk. Security Forces Hospital in Riyadh, and Prince Mohd Bin Nasser Hospital

Abstract

Medical record-keeping is critical in medical records since it is used as a source to offer continuity of patient care, clinical reasoning, medical research, and information of patients. The practice can be traced back to ancient times when people were using paper to store medical records. This has, however, been transformed by technology and has led to the adoption of the use of digital screens and Electronic Health Records (EHRs). This paper discusses the history of the paper records based on the importance they had in creating the medical records, so far as accessibility, readability, and analysis of the information were severely restricted by the records. The paper proceeds to mention the engines of the digital transformation, such as the necessity to be effective, improve patient safety, and the potential of data-driven healthcare. The introduction and impact of EHRs are critically evaluated. The advantages of EHRs are also mentioned, such as the strong enhancement of care coordination, clinical decision support, and research assistance, but the implementation problems are too numerous, such as the high cost of implementation, lack of interconnectivity, the problem of usability, and risk of data security. The paper will conclude by giving a prognosis of the future of the medical records, considering new opportunities of artificial intelligence, the portal accessible to patients, blockchain technology, and genomic integration. It is not only the process of transforming the paper into digital that is discussed as the technological upgrade but also the entire paradigm shift that is yet to redefine the very essence of healthcare provision, clinical process, and the relationships between the patient and the provider.

The Evolution of Medical Record-Keeping: From Paper to Digital Screen

The medical record as we know it is the historical record of the health history of a patient and the clinical interventions that have been offered to the patient. It is the cardiovascular nerve system of the medical services provision, the source of facts, but it must be accurate, convenient, and practical in order to effectively diagnose, cure, and save care. The methodology of how this crucial data can be documented, stored, and accessed has been

Power System Technology
ISSN:1000-3673
Received: 06-09-2025 Revised: 15-10-2025 Accepted: 07-11-2025

transformed in the last 5 decades—it is no longer documented on paper charts that have to be locked in the crowded filing rooms but rather on the computer interfaces that can be accessed anywhere in the world with the help of a screen. This is one of the radical historical transformations of paper to digital in the healthcare sector and has hit all stakeholders of the healthcare system, including the physician/nurse and the patient/policymaker.

The medical record was a paper-based document, and the standard of paper-based medical records was known as the chart, and this had been the case over centuries. These physical records of patient encounters were in the form of handwritten notes, typed reports, and pasted lab slips, which formed the main method of documenting patient encounters. Although they were an important evolution in the direction of formal medical records, they were at the same time limited in a fundamental way. They were unique, place-based objects, which are vulnerable to loss and damage, as well as decay. The problem of poor handwriting posed a constant risk to the safety of patients, and the search, analysis, and sharing of information were not fast enough to support the individual work with patients and the health programs of the population.

The digital age was to provide some kind of redemption to these prehistoric vices. As technology advanced, healthcare costs increased, and more attention was paid to patient safety, the trend of switching to digital storage of records began to gain momentum in the late 20th century, and this benefit has been overwhelmingly high in the early 21st century with government incentives (Abernethy et al., 2022). The resultant effect of this has been the massive adoption of Electronic Health Records (EHRs) and Electronic Medical Records (EMRs), which are supposed to hold patient information in a structured, calculable format. It is not just the moving of the medium but the re-engineering of the clinical working process, the information management, and even the epistemology of the medical practice.

The Era of Paper

The systematic medical record-keeping can usually be traced back to the influential contribution of Hippocrates in ancient Greece, who insisted on the importance of observation and documentation of the progression of illnesses. Nevertheless, the patient-centered medical record concept commenced to form in the hospitals of Renaissance Europe and was made more formal in the 19th and early 20th centuries (Lorkowski & Pokorski, 2022). The proposal of the problem-oriented medical record (POMR) by Dr. Lawrence Weed in the 1960s was one step in this direction, as it introduced a standardized format (Subjective, Objective, Assessment, Plan—SOAP) that added logic and organization to the process of taking clinical notes, and it continues to serve as one of the models on which this process can be based, whether on paper or on computers.

Power System Technology
ISSN:1000-3673
Received: 06-09-2025 Revised: 15-10-2025 Accepted: 07-11-2025

Despite the weaknesses of the paper-based system, it was very necessary. It gave a legal account of the care given, a communication device between the members of a care team (but late), and a history that could be referred to in the future. The physical chart was a physical one, and its contents—the ink, the written hand, and the notes that were added to the physical chart—had more nuances that some clinicians believe are lost with digital templates. Nevertheless, the weaknesses of the paper record were internal and harmful. Its single nature was the most mentioned weakness. A chart could be at a single place at a given time. When a primary care doctor required consultation services of a specialist, the chart had to be physically carried and time was frequently lost, misplaced, or the clinician had to work with an incomplete copy. This directly hampered coordinated care, in particular, with patients with multiple provider conditions.

Secondly, retrieval and analysis of data were extremely hectic. A clinician would need to go through years of progress notes to find and transcribe every value, which would take a long time to review the trend of a patient's blood pressure over the past several years (Kadakia et al., 2021). This rendered population health administration, quality improvement programs, and clinical research extremely hard. It took titanic effort to combine data in a basic study, such as the efficacy of a specific drug.

Third, the safety of the patients was constantly violated. Poor handwriting is a mythical issue in the field of medicine, and this has caused drug errors, misidentification, and surgery errors. Moreover, the paper records were usually not organized well, and essential data such as drug reactions or the advanced directives could be found deep in the file or completely absent. The absence of standardized forms and prompts resulted in documentation being highly diverse, and it was very much within the diligence and style of the particular clinician.

It was also physically cumbersome to the healthcare institutions because paper records are a massive administrative and financial burden. Medical records libraries also took up much space, and filing and retrieving them as well as organizing required hundreds of people. The system was very simply nonproductive and costly and was not suitable to the complexity of contemporary, data-heavy medicine. These shortcomings provided a fertile base through which a technological discontinuity arose that would have brought much efficiency, safety, and intelligence to healthcare documentation.

Digital Dawn: Drivers and Early Implementation.

Convergence of technology, economics, and politics resulted in a slow process of transition to digital medical records that could not happen overnight. The first attempts at computer-based patient records date back to the 1960s and 1970s in the early academic medical centers and government hospitals, including the COSTAR system at the Massachusetts General Hospital and the Technicon system at the El Camino Hospital. These pre-mechanized systems

Power System Technology
ISSN:1000-3673
Received: 06-09-2025 Revised: 15-10-2025 Accepted: 07-11-2025

were likely to be in-house, very costly, and lacking in features, and they tended to be narrowly confined either to laboratory output or to billing. Real motives for mass adoption gained stronger force during the 1990s and the first part of the 2000s. This has, however, been transformed by technology and has led to the adoption of the use of digital screens and Electronic Health Records (EHRs). This paper discusses the history of the paper records based on the importance they had in creating the medical records, so far as accessibility, readability, and analysis of the information were severely restricted by the records. The paper proceeds to mention the engines of the digital transformation, such as the necessity to be effective, improve patient safety, and the potential of data-driven healthcare. The introduction and impact of EHRs are critically evaluated.

One of the main triggers was the landmark report of the Institute of Medicine (IOM), to err is human: Building a safer health system (1999) (Narayan et al., 2025). This report generated an incredible alarm on the high medical errors in the hospitals, with an estimate of up to 98,000 deaths every year in the United States alone. The authoritative IOM cited the disjointed, paper-based record system as a primary factor and literally suggested the implementation of EHRs as an important measure of enhancing patient safety through medication error reduction and increased access to patient information.

Simultaneously, the information technology was rapidly developed and made digital solutions more viable and effective. The necessary infrastructure was provided through the introduction of the personal computer, the local area networks, and the internet. Data standards, which included Health Level Seven (HL7), also started to develop a common language that various systems would use to share clinical information to establish a base of interoperability.

The Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009 was the most influential policy maker in the United States that had a spillover impact on other countries across the world. This was legislation contained in the American Recovery and Reinvestment Act, and it provides more than 30 billion dollars to facilitate the implementation and meaningful use of the EHRs. It established a system of financial incentives for providers who had proven they were utilizing certified EHR technology to enhance care and, subsequently, fines on those that failed to do so. This carrot-and-stick model made the adoption curve shoot up.

The initial conception of the digital records was extremely potent: one and universal record, one related to all patients, which will be available everywhere and at any time so long as the individual is authorized to access such records. It assured to eradicate lost charts and illegible handwritings as well as give the clinicians a general and transparent picture of the patient history. Something beyond a replica of the paper record was promised and what drove

Power System Technology
ISSN:1000-3673
Received: 06-09-2025 Revised: 15-10-2025 Accepted: 07-11-2025

the digital dawn was an active instrument that could be used to enhance clinical decision-making and efficiency.

The Electronic Health Records Age (EHR).

The various positive outcomes of the widespread implementations of the EHRs are tangible and meaningful and have already started to transform the already predicted scenario of a safer, more efficient, and even smarter health care establishment into practice. An Electronic Medical Record (EMR) and an Electronic Health Record (EHR) are not very different, though a more specific patient history across providers is still anticipated to be exchanged between the different healthcare settings. An EMR represents only a digital manifestation of a patient chart in a single practice or clinic (Tayefi et al., 2021). The modern EHR is the support of the digital health infrastructure whose impact is complicated.

Accessibility and care coordination with the introduction of HER: The direct benefit of EHRs is the real-time availability of patient information. With a patient record, an authorized clinician is able to access a patient simultaneously in either a clinic, emergency department, or hospital floor. This contributes to better coordination of care, especially in passing off care, i.e., from a hospital to a rehabilitation center. Prior to a consultation, a specialist may review the notes and test results of a primary care physician and remove redundant tests and provide a more realistic foundation of care.

HHR improvement has also resulted in the enhancement of patient safety and care quality: there are numerous time-saving features of EHRs that can exclude errors. The Computerized Physician Order Entry (CPOE) eliminates the possibility of the illegible handwritten medication and test orders. The Clinical Decision Support (CDS) systems provide drug-drug interaction notifications, drug-drug conflicts of allergy, and nature of guidance-based care notifications. An example is that an EHR can alert a physician who prescribes a medication to which the patient is allergic or remind a diabetic patient that he/she has failed to receive a foot check-up recently. Such computerized protective protocols have been helpful in reducing the negative drug events as well as increasing the rate of compliance with clinical orders.

Another HHR's benefit is it led to efficiency and operational gains: Although the effect of EHR initially had a negative influence on physician workflow, there can be long-term efficiencies when EHRs are well implemented. E-prescribing enables straight electronic transfer of the prescriptions to the pharmaceutical outlets to save on time and mistakes (Chang et al., 2023). Administrative processes can be made more efficient by using automated coding and billing assistance to enhance management of the revenue cycle. Another way digital storage removes the physical space and staff expenses of dealing with paper records is the fact that the former needs no physical space or staffing.

Power System Technology
ISSN:1000-3673
Received: 06-09-2025 Revised: 15-10-2025 Accepted: 07-11-2025

Data analytics and population health management also improved. EHRs provide a significant opportunity due to their ability to structure clinical data in a computable and, hence, analyzable format. It has enabled healthcare organizations to create reports on clinical quality measures easily and monitor outcomes on a given group of patients and gaps in care (Hager et al., 2024). An example is that a health system could soon produce a list of all heart failure patients who have not yet been prescribed a beta-blocker so that they can reach out and intervene specifically. It is a shift in medicine that now has been anecdotal to data-dominated medicine, which is the root of the current value-based care and population health.

In addition, EHR caused an improvement in patient engagement and empowerment: A built-in patient portal is one of the foundations of the modern EHRs. These are secure internet-based tools where patients can access their own health information, including lab reports, visit reports, and medication histories. They tend to possess other functionalities of safe communication with providers, requesting them to refill their prescriptions and appointments. It results in a more collaborative relationship between the patients and the provider, and more power is granted to the patients to actively contribute to their treatment, and it increases compliance with the treatment plans.

Usually, the revolutionary aspect of the EHR lies in the fact that it will leave the medical record in the passive role of a storage of information and become an active component of the care process. It is a platform that does not only enable storage of data but also analysis and presentation and is smart in assisting the clinicians and the patients, which essentially enhances the quality of safety and effectiveness of healthcare delivery.

The Issues and Unintentional Consequences of Digitalization.

The process of paper-to-digital transformation has been fraught with challenges and has vastly affected the unintended impact, despite the fact that the transformation has led to enormous benefits (Stoumpos et al., 2023). The socio-technical process of EHR implementation has not been a smooth ride, which has changed the clinical processes and the provider-patient relationship in a manner that was not inevitably anticipated.

Financial and Implementation Burdens: Purchasing and implementing an EHR system is initially very expensive, usually in the millions of dollars when applied to a hospital and tens of thousands when applied to a small practice (Salmani et al., 2024). Not only is the software license included in these costs, but also hardware upgrades, network infrastructure, and extensive staff training. This financial barrier has been one of the incentives behind the creation of larger hospital systems through the consolidation of many smaller practices.

Interoperability: The Persistent Digital Silo: Likely the biggest current issue is the absence of easy-going interoperability, i.e., of various EHR systems to exchange, interpret, and utilize the data. Although the vision was one lifelong health record, it is usually a world of

Power System Technology
ISSN:1000-3673
Received: 06-09-2025 Revised: 15-10-2025 Accepted: 07-11-2025

digital silos. The records of a patient at a hospital with a vendor system may not match well with that of a specialist who uses a different vendor system. Information is frequently shared in the form of unstructured PDF files, which cannot be easily searched and analyzed, recreating the shortcomings of paper in an online environment. Such discontinuity has a negative effect on the coordination of care and the achievement of a full-fledged EHR.

Usability and Clinician Burnout: Several EHR systems have been cited to have poor usability. Red tape navigation, too much clicking, and too many data entry processes can slug clinicians and interfere with the flow of communication with the patient. Another trend has been the rise of the so-called iPatient, in which a doctor is found to spend more time typing the care in the computer than talking to the real patient in the room. It is also more likely to produce what is often known as note bloat, in which the progress notes have already been converted into lengthy and standardized template notes that are hard to read as well as obstruct the significant clinical story (Ripp et al., 2025). This clerical load could be deemed as one of the largest causes of augmented burnout and dissatisfaction by physicians.

Security and Privacy Issues: Info Aggregation When they take an enormous load of sensitive patient data and put it into electronic storage opportunities, they become a lucrative target for cybercriminals. The information that is highly personal may leak out because of a health care data breach, and its effects are catastrophic on the patients. The need to ensure EHR data security and privacy has been an inherent demand, which, in particular, means that as a routine, the management needs to combat the problem of ensuring high-level security by using effective cybersecurity, training the personnel, and using effective access control, which is never an easy task that healthcare organizations are forced to face.

Laws and Ethics: The online record presents a novel legal dilemma. The convenience and the possibility to copy and paste the text may cause the repetition or wrongful errors in the record. The audit trail becomes a legal liability as well, although it is important to have due to accountability in the EHR. Moreover, patient portals may increase the digital divide, or the divide between people who do and do not have access to technology, which may leave behind the older, poorer, or less tech-savvy population.

These issues explain that the transformation to digital is not a panacea. It has substituted the previous issues of paper with a new set of complex technologically mediated issues. These issues can only be solved by not only focusing on the technology itself but also on user-focused design, policy to favor open data standards, and a cultural change within the healthcare organizations to utilize the technology in a manner that facilitates as opposed to impedes the humanness of care.

Power System Technology
ISSN:1000-3673
Received: 06-09-2025 Revised: 15-10-2025 Accepted: 07-11-2025

The Future Trajectory

The development of the medical record is not yet over. Trends and new technologies are leading to the future where the EHR becomes less a system of record and more a patient-centered health and wellness platform. There are a number of events that are dominating this new phase.

Artificial Intelligence (AI) and Machine Learning AI will transform the manner in which data in EHRs is utilized. With machine learning algorithms, large data sets can be processed to determine the patterns that cannot be seen by the human eye (Gómez et al., 2021). It can be used to forecast patient risks (e.g., predicting sepsis or hospital readmissions), aid in diagnostics (e.g., identifying a suspicious lesion in radiology images), and tailor treatment plans through recommending therapies based on what other patients of similar profiles would have. Unstructured clinical notes can also be used to create value by utilizing AI-based natural language processing (NLP) to transform physician notes into a format that can be analyzed.

Health Data Generated by Patients (PGHD) and the Internet of Things (IoT): The future health record will go way beyond the four clinic walls. Wearables (e.g., smartwatches that monitor heart rhythm), home health (e.g., Bluetooth-enabled blood pressure cuffs), and mobile health apps result in the creation of a constant stream of PGHD. The added value of this real-world, real-time data to the EHR will help create a more comprehensive and dynamic view of the health of a patient and achieve more proactive and preventive care, especially when managing chronic diseases.

Secure Health Information Exchange on Blockchain: In order to solve the interoperability and security issues, there is a consideration of blockchain technology. A system utilizing blockchain has the potential to provide a safe, decentralized registry of exchanges of patient data that places more control in the hands of the patient and an open and unalterable audit trail (Sheikh et al., 2021). This would likely destroy the digital silos and place the patients in the position of the actual owners of their health data.

Genomic Integration: As the cost of genomic sequencing continues to decrease, it is inevitable that a genome will be integrated into the EHR of a patient (Murdoch, 2021). This will permit real personalized medicine, in which the treatment and drug prescriptions will be administered taking into consideration the genes of a single person, and this will guarantee the highest level of effectiveness and the lowest side effects.

The Patient as Partner: This is a future trend of a completely transparent and shared record. Patient portals will turn into sophisticated instruments of shared care wherein not only can patients gain access to their information but also develop it, comment on it, and be directly involved in the process of setting care goals (Vaisson et al., 2021). The document will be a

Power System Technology
ISSN:1000-3673
Received: 06-09-2025 Revised: 15-10-2025 Accepted: 07-11-2025

shared venue of discussion and shared health management, which will effectively change the relationship between the patient and the provider.

Overall, the transition from the paper record-keeping system to the use of modern technology has transformed the health industry to run a smoother operation in the provision of health care and health record keeping. It is a procedure of transferring between the paper chart, its local, concrete, and even chaotic reality, and the Electronic Health Record and its abstract, universal, and organized reality. The need to integrate towards the security of the patients and the effectiveness and utility of the data has completely transformed the healthcare situation. Digitalization has brought about a lot of opportunities and may even reverse the healthcare industry. Therefore, the impact it will have on the healthcare sector should not be underestimated.

The EHR is now an inseparable part of the new clinical arsenal and offers a new level of care coordination and clinical intelligence never witnessed in the paper age. This has come, however, with costs and complications of this change. These electronic growing pains are extremely expensive in monetary terms, continuous compatibility destruction, and usability that is leading clinicians to burnout and making them more prone to data attacks. This visit has helped to learn that the process of implementing the technology is a human effort, which must be matched accordingly by the human factor, workflow, and culture as the software itself.

The pace of its development will now be even more rapid in the future. Artificial intelligence with patient-generated data and genomic data will certainly bring the EHR to the next level as not only a documentation system but also an effective predictive, personalized, and participatory health platform. The final end is the same: to make sure that the right information is prepared at the right time and shared with the right person to be able to make the most appropriate health decisions. Starting with the primitive paper passbook and moving on to the artificial intelligence-powered health assistant, the medical history of the medical record is unquestionably connected to the ancient motto of the medicine profession: to know, to cure, and to love.

References

1. Abernethy, A., Adams, L., Barrett, M., Bechtel, C., Brennan, P., Butte, A., ... & Valdes, K. (2022). The promise of digital health: then, now, and the future. *NAM perspectives*, *2022*, 10-31478. https://pmc.ncbi.nlm.nih.gov/articles/PMC9499383/

2. Chang, H., Choi, J. Y., Shim, J., Kim, M., & Choi, M. (2023). Benefits of information technology in healthcare: artificial intelligence, internet of things, and personal health records. *Healthcare informatics research*, *29*(4), 323-333. https://synapse.koreamed.org/articles/1516084704

Power System Technology
ISSN:1000-3673

Received: 06-09-2025 Revised: 15-10-2025 Accepted: 07-11-2025

3. Gómez, C. A., Kleinman, D. V., Pronk, N., Gordon, G. L. W., Ochiai, E., Blakey, C., ... & Brewer, K. H. (2021). Addressing health equity and social determinants of health through healthy people 2030. *Journal of public health management and practice*, *27*(Supplement 6), S249-S257. https://journals.lww.com/jphmp/fulltext/2021/11001/addressing_health_equity_and_social_determinants.9.aspx

4. Hager, P., Jungmann, F., Holland, R., Bhagat, K., Hubrecht, I., Knauer, M., ... & Rueckert, D. (2024). Evaluation and mitigation of the limitations of large language models in clinical decision-making. *Nature medicine*, *30*(9), 2613-2622. https://www.nature.com/articles/s41591-024-03097-1

5. Kadakia, K. T., Howell, M. D., & DeSalvo, K. B. (2021). Modernizing public health data systems: lessons from the Health Information Technology for Economic and Clinical Health (HITECH) Act. *Jama*, *326*(5), 385-386. https://jamanetwork.com/journals/jama/fullarticle/2782635

6. Lorkowski, J., & Pokorski, M. (2022). Medical records: a historical narrative. *Biomedicines*, *10*(10), 2594. https://www.mdpi.com/2227-9059/10/10/2594

7. Murdoch, B. (2021). Privacy and artificial intelligence: challenges for protecting health information in a new era. *BMC medical ethics*, *22*(1), 122. https://link.springer.com/article/10.1186/s12910-021-00687-3

8. Narayan, A., Kaplan, R. M., & Adashi, E. Y. (2025). To err is human: a quarter century of progress. *Journal of General Internal Medicine*, *40*(3), 690-693. https://link.springer.com/article/10.1007/s11606-024-09087-w

9. Ripp, J. A., Pietrzak, R. H., de Guillebon, E., & Peccoralo, L. A. (2025). Association of clerical burden and EHR frustration with burnout and career intentions among physician faculty in an urban academic health system. *International Journal of Medical Informatics*, *195*, 105740. https://www.sciencedirect.com/science/article/abs/pii/S1386505624004039

10. Salmani, H., Nasiri, S., & Ahmadi, M. (2024). The advantages, disadvantages, threats, and opportunities of electronic patient-reported outcome systems in cancer: A systematic review. *Digital Health*, *10*, 20552076241257146. https://journals.sagepub.com/doi/full/10.1177/20552076241257146

11. Sheikh, A., Anderson, M., Albala, S., Casadei, B., Franklin, B. D., Richards, M., ... & Mossialos, E. (2021). Health information technology and digital innovation for national learning health and care systems. *The Lancet Digital Health*, *3*(6), e383-e396. https://www.thelancet.com/journals/landig/article/PIIS2589-7500(21)00005-4/fulltext

Power System Technology
ISSN:1000-3673

Received: 06-09-2025 Revised: 15-10-2025 Accepted: 07-11-2025

12. Stoumpos, A. I., Kitsios, F., & Talias, M. A. (2023). Digital transformation in healthcare: technology acceptance and its applications. *International journal of environmental research and public health*, *20*(4), 3407. https://www.mdpi.com/1660-4601/20/4/3407
13. Tayefi, M., Ngo, P., Chomutare, T., Dalianis, H., Salvi, E., Budrionis, A., & Godtliebsen, F. (2021). Challenges and opportunities beyond structured data in analysis of electronic health records. *Wiley Interdisciplinary Reviews: Computational Statistics*, *13*(6), e1549. https://wires.onlinelibrary.wiley.com/doi/full/10.1002/wics.1549
14. Vaisson, G., Provencher, T., Dugas, M., Trottier, M. E., Chipenda Dansokho, S., Colquhoun, H., ... & Witteman, H. O. (2021). User involvement in the design and development of patient decision aids and other personal health tools: a systematic review. *Medical decision making*, *41*(3), 261-274. https://journals.sagepub.com/doi/full/10.1177/0272989X20984134