TRANSDISCIPLINARY ISSUES OF THE UNITED STATES HEALTHCARE DELIVERY SYSTEM

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ABSTRACT

Aim/Purpose	This paper applies informing science principles to analyze the evolution of United States (U.S.) healthcare delivery, exploring how policy shifts, technological advancements, and changing practices have transformed informing processes within this complex system. By examining healthcare delivery through a transdisciplinary lens, we aim to enhance the understanding of intricate informing environments and their dynamics.
Background	The U.S. healthcare system epitomizes a complex, evolving transdisciplinary domain intersecting information systems, policy, economics, and public health. Recent transformations in stakeholder information flow necessitate an informing science perspective to comprehend these changes fully.
Methodology	We synthesize literature on U.S. healthcare delivery changes, employing informing science frameworks such as Cohen's "informing environment" concept to analyze the evolution of healthcare informing processes.
Contribution	This study expands informing science theory by examining how changes in a complex transdisciplinary system impact information flow, decision-making, and

	stakeholder interactions. The results provide insights into challenges and opportunities within evolving informing environments.
Findings	Our analysis reveals significant alterations in the U.S. healthcare informing landscape due to policy, regulatory, and technological changes. We identify key transformations in client-sender-delivery system relationships, shifts in information asymmetry, and the emergence of novel informing channels and barriers.
Recommendations for Practitioners	Healthcare professionals should adapt their strategies for patient communication, data management, and service delivery to account for the evolving informing environment.
Recommendations for Researchers	Future studies should develop informing science models capable of capturing the complexity and dynamism of healthcare delivery systems, particularly amidst rapid technological and policy changes.
Impact on Society	Understanding the informing aspects of healthcare evolution can lead to improved information flow, more informed decision-making, and enhanced patient outcomes.
Future Research	Further investigation is needed into how emerging technologies reshape healthcare informing processes and their impact on care quality, accessibility, and cost-effectiveness.
Keywords	healthcare delivery, informing science, transdisciplinary systems, health healthcare information flow, healthcare policy, technological innovation

INTRODUCTION

This paper describes the significant changes in U.S. healthcare delivery through policy development, technological advancement, economy, efficiency, accessibility, and quality outcomes. The U.S. healthcare system has undergone significant transformations, characterized by its complex, transdisciplinary nature that integrates policy, public health, and economic factors and evolution over the past two centuries (Yelton & Schoener, 2020). Riley and Vincent (2020) discussed the unique features of the U.S. healthcare system compared to those of other developed nations, emphasizing its reliance on private insurance and state programs. This complexity has been identified as a major obstacle (Liu et al., 2024), leading to challenges such as disparities in healthcare access. Efforts towards healthcare reform have been a recurring theme in the literature with the goal of ensuring fundamental healthcare coverage for all (Katirai, 2023). This study aims to provide insights that can inform policymakers and healthcare providers, leading to a more effective and equitable healthcare system. We explicitly focus on how healthcare delivery intersects with multiple disciplines, such as information systems, policy updates, public health, and economics, each contributing uniquely to its evolution. We provide implications for these disciplines to inform and influence each other in the context of healthcare evolution. The evolution of U.S. healthcare has undergone significant transformations in patient experiences over the past decades (Liu et al., 2024). Razzak et al. (2019) described how modern technology, medical tools, drugs, and treatments significantly increased healthcare administrative costs.

In 2010, President Obama signed an expansion of the Patient Protection and Affordable Care Act (ACA) to significantly increase health insurance coverage through Medicaid (Johnson et al., 2020). This comprehensive legislation aimed to increase health insurance coverage and improve healthcare delivery nationwide. The ACA implemented several key provisions: it mandated that Americans obtain health insurance or face a penalty (although this mandate was later reduced in 2019), expanded Medicaid eligibility in participating states, established health insurance marketplaces, and introduced

new regulations for insurance companies (Dodini, 2022). These measures collectively increased insured Americans, benefiting low-income adults and those with pre-existing conditions. The ACA also emphasized preventive care, requiring insurance plans to cover certain preventive services without cost-sharing. Furthermore, it introduced initiatives to improve healthcare quality and efficiency, such as promoting value-based care models and establishing ACOs. These changes expanded access to healthcare and began to reshape the healthcare delivery landscape, encouraging greater coordination among providers and a shift towards patient-centered care models. While the ACA has faced political challenges and undergone modifications since its inception, its impact on increasing insurance coverage and reshaping healthcare delivery practices remains significant in the evolving U.S. healthcare system.

Medicare and Medicaid were two cornerstone U.S. government healthcare programs established in 1965. Medicare primarily provides health insurance for Americans aged 65 and older and some younger people with specific disabilities. Medicaid, on the other hand, offers health coverage to eligible low-income adults, children, pregnant women, elderly adults, and people with disabilities (Johnson et al., 2020). These programs significantly expanded healthcare access and underscored the federal government's role in health services. From 1965 to 1985, significant changes occurred in Medicare as part of the Social Security Act. With the help of Medicare and Medicaid, prescription drug costs were covered, and federal assistance was provided for Medicare beneficiaries in managing medication costs. These programs ensured that vulnerable populations, including the elderly and low-income individuals, received necessary healthcare services (Larsson et al., 2019; Nguyen et al., 2023). These policy updates directly impacted healthcare delivery and accessibility in society. Healthcare options for non-U.S. citizens in the U.S. depend on their immigration status and how long they stay. Legal Permanent Residents (Green Card holders) can access Medicare and Medicaid after five years and buy insurance through the Health Insurance Marketplace. Temporary visa holders, such as students and workers, are not eligible for Medicare or Medicaid but can buy private insurance or get coverage through their employer, which is often required by their visa. Undocumented immigrants cannot access Medicare, Medicaid, or Marketplace insurance but can receive emergency care and may qualify for some state or local programs. Refugees and asylees are eligible for Medicaid and Marketplace coverage immediately and can access Medicare after five years. Short-term visitors are advised to purchase travel medical insurance before coming to the U.S., as they can receive emergency care but may be billed. Since healthcare policies for non-U.S. citizens are complex and can change, it is wise to seek advice from immigration attorneys or healthcare experts. Additionally, ensuring better data management and interoperability among healthcare providers (Larsson et al., 2019).

Healthcare delivery in the U.S. represents a prime example of a complex, evolving transdisciplinary domain. It involves intricate interactions between stakeholders, including patients, healthcare providers, insurers, policymakers, and technology developers. The system's complexity is further amplified by the need to balance quality of care, accessibility, cost-effectiveness, and technological innovation. By focusing on cost management of insurance and healthcare funding, which involves integrating transdisciplinary knowledge on healthcare delivery, we aim to contribute to the broader understanding of complex informing environments (Kadakia & Offodile, 2023). The cost of treatments for chronic disease conditions like diabetes, heart disease, and obesity has increased among patients. Lack of price transparency among healthcare providers contributes to higher consumer costs (Johnson et al., 2020). Collaboration between healthcare funding and insurance markets is interrelated in economic principles for managing the cost of healthcare delivery (Cazorla-Morales et al., 2024).

The U.S. healthcare system faces significant economic challenges, particularly in the realms of chronic disease management and price transparency. Chronic conditions such as diabetes, heart disease, and obesity have become increasingly prevalent, leading to a substantial rise in healthcare costs. These conditions often require long-term treatment and management, placing a heavy financial bur-

den on patients and the healthcare system (Khalili, 2024). The Centers for Disease Control and Prevention estimates that chronic diseases account for 90% of the nation's $3.8 trillion in annual healthcare expenditures. Compounding this issue is the lack of price transparency in the healthcare market. Compared to other sectors of the economy, healthcare consumers often need help to obtain clear, upfront pricing information for medical services and treatments. This opacity in pricing makes it difficult for patients to make informed decisions about their care or to compare costs across different providers (Kadakia & Offodile, 2023). The absence of transparent pricing also contributes to wide variations in the cost of identical procedures across different hospitals and regions, sometimes differing by thousands of dollars. This lack of transparency affects individual patients and impacts employers, insurers, and government programs that bear significant healthcare costs. Recent policy initiatives, such as the Hospital Price Transparency Rule implemented in 2021, aim to address this issue by requiring hospitals to provide clear, accessible pricing information to consumers. However, compliance and enforcement remain ongoing challenges. The intersection of rising chronic disease costs and lack of price transparency creates a complex economic landscape in U.S. healthcare. This underscores the need for comprehensive reforms that address long-term health conditions and greater clarity in healthcare pricing (Carvalho et al., 2024).

Post-COVID-19 pandemic, providers enabled telehealth services to access healthcare without physical visits, as Ehizogie et al. (2024) discussed. This allowed healthcare providers to monitor patients' health status after discharge and consider re-admission if needed (Paraschiv et al., 2021). Telehealth emphasizes collaboration among providers, insurers, policymakers, and patients from different backgrounds (Ehizogie et al., 2024). Telehealth platforms allow healthcare providers to conduct remote consultations, efficiently track patient health, and work with colleagues from a distance (Udegbe et al., 2024). This enhances care coordination, allows for continuous patient monitoring, and reduces costs by decreasing the need for emergency room visits (Larsson et al., 2019).

The HITECH Act, enacted as part of the American Recovery and Reinvestment Act of 2009, marked a pivotal moment in modernizing U.S. healthcare information systems. This legislation was designed to promote and expand the adoption of health information technology, particularly EHRs. The HITECH Act provided substantial financial incentives for healthcare providers to adopt and demonstrate "meaningful use" of certified EHR technology. These incentives, which could amount to tens of thousands of dollars per eligible professional, significantly accelerated the implementation of EHRs nationwide. The Act also established the ONC for Health Information Technology as a permanent entity overseeing the development of a nationwide health information technology infrastructure. By digitalizing patient records, the HITECH Act aimed to improve several aspects of healthcare delivery:

1. enhancing the accuracy and availability of patient information,
2. facilitating better care coordination among providers,
3. reducing medical errors, and
4. enabling more efficient and effective patient care.

Furthermore, the Act emphasized the importance of data interoperability, pushing for standards allowing different EHR systems to communicate and share information seamlessly. This focus on interoperability was crucial for creating a more connected and integrated healthcare ecosystem. The impact of the HITECH Act has been substantial, with EHR adoption rates in hospitals rising from approximately 10% in 2008 to over 80% by 2015. This rapid digitalization of health records has set the stage for further innovations in healthcare delivery, including the development of clinical decision support systems, population health management tools, and the application of big data analytics in healthcare. EHRs involve contextualization problems and require local knowledge and perspectives. Providers use them to share patient information across different departments and specialties. This is an advantage because EHRs can minimize errors and ensure that all providers involved in a patient's care have up-to-date information (Cardile et al., 2023). Digital records ensure more accurate and accessible information, allowing insurers to bill and quickly identify fraud in the insurance process

(Ehizogie et al., 2024). Policymakers emphasized that aggregating historical data and measuring impact through data analytics in healthcare information systems helps predictive modeling and enables data-driven decisions to improve healthcare delivery and outcomes. Researchers were urged to develop cross-disciplinary, collaborative methods that offer robust evidence and comprehensive insights into complex issues.

HIEs ensure patient data is available for professionals from different disciplinary backgrounds, such as patients, providers, and policymakers (Larsson et al., 2019). They aim to create new knowledge and solve problems to produce valuable health outcomes through diverse expertise. For example, insurers benefit from HIEs through improved data analysis and risk assessments that inform accuracy and timeliness, aiding in better policy pricing and quality care management (Tsutakawa, 2022). Providers and patients engage in effective cross-disciplinary communication and boundary-crossing discourse, which helps address transdisciplinary and cross-disciplinary collaboration issues. This fosters collaboration as a normative aspect of professional effectiveness (Hamilton et al., 2020). HIEs also consider social and ethical implementation characteristics to solve complex challenges comprehensively. This collaborative approach helps address transdisciplinary and cross-disciplinary collaboration issues, promoting it as a normative aspect of professional effectiveness (Hamilton et al., 2020). Furthermore, HIEs consider social and ethical implementation characteristics to solve complex challenges comprehensively. By facilitating seamless information exchange, HIEs improve care coordination, enhance decision-making, and improve patient outcomes. They serve as a cornerstone for integrating diverse healthcare perspectives and promoting a more holistic approach to patient care.

This transdisciplinary nature seeks to integrate knowledge and methods from multiple fields to create a new, unified framework. Economic policies impact public health initiatives and research. Moreover, the U.S. healthcare system is more costly and complicated than those of other developed nations (Khalili, 2024). Costs are driven by traditional Fee-For-Service (FFS) payment models, hidden charges on HIT infrastructure, and factors hindering care coordination through value-based health service delivery (Kadakia & Offodile, 2023). Healthcare professionals should consider the evolving environment when developing strategies for patient communication, data management, and service delivery. The concept of optimizing system effectiveness is crucial for healthcare delivery (Cohen, 2009).

Our research sought to answer the following three questions about why healthcare delivery is a trans-disciplinary and cross-disciplinary issue that involves exchanges among patients, healthcare providers, and suppliers:

1. How does healthcare delivery intersect with multiple disciplines, such as information systems, policy, economics, and public health, and how do these disciplines inform and influence each other in the context of healthcare evolution?
2. In what ways have technological advancements in healthcare delivery impacted the quality and efficiency of information exchange among stakeholders?
3. How has the evolution of the U.S. healthcare system influenced the informing environments within which healthcare decisions are made?

These questions are designed to explore the multifaceted nature of healthcare delivery and its transformation over time. By examining the interconnections between various disciplines, the impact of technology, and the changing informing environments, we can gain a more comprehensive understanding of the forces shaping modern healthcare. This research aims to provide insights that can inform policymakers, healthcare providers, and technologists, ultimately contributing to developing a more effective, efficient, and equitable healthcare system. The findings from this study have the potential to guide future healthcare reforms, improve patient outcomes, and enhance the overall quality of care delivery in the United States.

PURPOSE

This paper aims to describe the significant changes in U.S. healthcare delivery over the past two centuries through policy development, technological advancement, economic efficiency, accessibility, and quality outcomes. We examine healthcare delivery, analyzing how policy developments, technological advancements, and changing practices have transformed the informing processes and environments within the healthcare system (Kadakia & Offodile, 2023). This dynamic evolution has been driven by various factors, including technological advancements, policy reforms, demographic shifts, and changing societal expectations (Kadakia & Offodile, 2023).

Naik et al. (2022) explored the current state of the U.S. healthcare system, its historical context, and key milestones that have shaped its development. By focusing on the transdisciplinary concept of healthcare delivery, we aim to contribute to the broader understanding of complex informing environments (Drago et al., 2018). A transdisciplinary approach is crucial to enhance our complex informing environment. Transdisciplinary healthcare collaboration involves knowledge integration from various disciplines to address complex changes (Mokiy & Lukyanova, 2022). This approach promotes shared competencies among healthcare professionals and the ability to identify common patient care goals (Drago et al., 2018).

Transdisciplinary teams can develop innovative solutions by integrating knowledge from multiple fields of different experts (Thompson et al., 2023). Our purpose is to optimize the integration of various healthcare professionals and their specific expertise through interactions and discussions that provide focused input to enhance patient outcomes (Ehizogie et al., 2024). This approach boosts efficiency among providers, health insurance providers, and healthcare policymakers from diverse backgrounds, enhancing patient satisfaction (Lemieux-Charles & McGuire, 2021). Furthermore, transdisciplinary problem-solving is essential for tackling issues that transcend traditional disciplinary boundaries and support optimal outcomes for healthcare delivery while prioritizing patient health and environmental sustainability (Mokiy & Lukyanova, 2022).

Transdisciplinary research methodologies can transform healthcare delivery by synthesizing various theories and approaches, such as informing science, implementation science, and systems theory (Regan, 2022). We could use this framework to analyze how different disciplines interact in healthcare, showing how attempts to solve one "puzzle" or "problem" can impact others. This approach could provide insights into why some healthcare policies have unintended consequences by showing how they might be treating a "mess" as a "problem" or a "puzzle" (Ackoff, 2006). In this article, we selected informing science because the problem is particularly suited to designing solutions that inform clients more effectively. This approach applies to emergency public health environments that need solutions beyond traditional disciplinary boundaries (Thompson et al., 2023). By adopting transdisciplinary intellectual theory, healthcare professionals can gain a comprehensive perspective that includes expertise from diverse fields, such as engineering, social sciences, and healthcare (Mokiy & Lukyanova, 2022).

The concept of fragility, as introduced by Cohen (2009) in the informing science framework, plays a crucial role in understanding the challenges and opportunities in healthcare delivery. In healthcare, this concept helps us identify potential points of weakness in the complex web of interactions between patients, providers, technologies, and organizations. Fragility in healthcare delivery refers to the vulnerability of information flow within the system, making it prone to disruptions or failures. This fragility is evident in the transfer of information between providers, patients, and different healthcare institutions, the heavy reliance on technology like EHRs, and the challenges posed by human factors such as cognitive limits and communication barriers. Organizational complexities, along with rapidly changing regulations, further contribute to fragility. Addressing these vulnerabilities is essential to creating more resilient and effective healthcare systems that ensure reliable and accurate information flow.

BACKGROUND

The U.S. healthcare system is a complex domain intersecting with various disciplines, including health information systems, policy, economics, and public health. Recent years have seen significant changes in health information systems among stakeholders, necessitating an informative science perspective to understand these transformations (Luo et al., 2018; Mokiy & Lukyanova, 2022; Wan et al., 2017). Healthcare providers in the U.S. face numerous challenges in delivering high-quality care. Burnout among healthcare professionals has reached alarming levels, exacerbated by administrative burdens, long working hours, and emotional stress (Jihn et al., 2021). Workforce shortages, particularly in nursing and primary care, strain the healthcare system.

The evolution of U.S. healthcare has resulted in improvements through interdisciplinary collaboration, addressing aspects such as costs, quality persistence, and urgent reform (Aarons et al., 2019). Contemporary county and state medical societies provide platforms for knowledge sharing and discussing various health-related topics (Gonzalez et al., 2024; Tripicchio & Anderson, 2023). The vision for future healthcare systems emphasizes comprehensive, high-quality services tailored to diverse populations through multidisciplinary teams across various settings (Araja et al., 2023).

Adopting a transdisciplinary approach in healthcare delivery involves a transformational research methodology that integrates various disciplines for advancing interventions and expanding scientific frontiers (Lemieux-Charles & McGuire, 2021; Mokiy & Lukyanova, 2022). This approach can address healthcare system challenges, including sustainability issues and health inequities, through stakeholder coordination and organizational capacity building (Thompson et al., 2023; Wickman et al., 2021).

The evolution of Medicare and Medicaid has played a crucial role in expanding healthcare access. Significant changes occurred between 1965 and 1985, including expanding coverage to young people with disabilities and patients at risk of renal disease (Johnson et al., 2020; Nguyen et al., 2023). The transformation from fee-for-service payment models to patient-centered medical homes and accountable care organizations has reshaped information exchange within the healthcare system (Grys, 2022). The U.S. healthcare system remains more costly and complicated than other developed nations, driven by various factors, including traditional payment models and barriers to care coordination (Kadakia & Offodile, 2023; Khalili, 2024).

The shift towards value-based care models has required providers to adapt their practices and financial models (Folse et al., 2024). While these models aim to improve quality and reduce costs, they also present implementation and risk management challenges for providers (Rangachari, 2023). Policy changes have shaped the healthcare landscape. Technological innovations have been equally transformative and have significantly impacted hospital profitability and patient care. The introduction of payment reform and value-based care models has focused on quality over quantity, altering hospital revenue streams (Folse et al., 2024). The trend toward hospital consolidation continues, driven by the need to meet accreditation standards and leverage economies of scale (Devkaran et al., 2019). Key legislative actions, such as the Health Insurance Portability and Accountability Act (HIPAA) in 1996 and the creation of the State Children's Health Insurance Program (CHIP) in 1997, have further shaped the U.S. healthcare system by protecting patient privacy and expanding coverage for vulnerable populations (Ehizogie et al., 2024; Folse et al., 2024).

Technological advancements, including artificial intelligence (AI) and telehealth, have revolutionized healthcare delivery, improving information flow and stakeholder collaboration (Idris et al., 2024; Wosik et al., 2020). These innovations have significantly impacted the quality of healthcare services and stakeholder engagement. For instance, AI-powered imaging analysis tools assist radiologists in detecting early signs of diseases like cancer and Alzheimer's with greater precision. Telemedicine, accelerated by the COVID-19 pandemic, has emerged as a critical component of healthcare delivery (Araja et al., 2023). It has improved access to care, particularly for rural and underserved populations,

while presenting new challenges in digital literacy and equitable access to technology (Carroll et al., 2024).

TRANSDISCIPLINARY CHARACTERISTICS AND ASSUMPTIONS

Several researchers' expositions about transdisciplinary characteristics and assumptions are increasingly recognized for their significant role in shaping the evolution of U.S. healthcare. The evolution of U.S. healthcare is increasingly shaped by transdisciplinary approaches, necessitating a multifaceted policy change involving community engagement, technological innovation, and improvements in delivery (Lara-Millán & Ruppel, 2024). The hospital admissions and re-admissions landscape has shifted towards a more collaborative and integrated approach. This shift emphasizes team-based care over individual expertise, promoting shared competencies among healthcare professionals from different disciplines (Larsson et al., 2019; Lemieux-Charles & McGuire, 2021).

Research continues to explore transdisciplinary issues in the U.S. healthcare system, focusing on cross-disciplinary engagement and healthcare disparities (Larsson et al., 2019). Policy and regulatory developments encourage coordinated care, bringing together diverse healthcare providers to improve patient outcomes and reduce costs (Kasula, 2021). Also, cross-disciplinary issues can be addressed as different health information systems exchange patient information effectively, encouraging collaboration across disciplines (Kanakubo & Kharrazi, 2019).

Adopting a transdisciplinary approach can increase workforce productivity, improve patient outcomes, and enhance organizational sustainability (Thakur & Hossain, 2023). This approach holds promise in generating innovative solutions to complex research problems, such as addressing the needs of diabetes patients with comorbidities (Johnson et al., 2020).

Informing science has improved chronic disease outcomes by enabling remote patient monitoring and fostering collaborative engagements between patients and healthcare providers (Carvalho et al., 2024). The COVID-19 pandemic accelerated the adoption of telehealth services, allowing for better post-discharge monitoring (Ehizogie et al., 2024). This emphasis on interdisciplinary collaboration has fostered a more cost-effective and quality-focused approach to healthcare delivery (Hamilton et al., 2020). Effective communication between patients and providers is crucial in generating new knowledge, as solutions to complex problems cannot be confined to single disciplines. More effective solutions can be achieved through collaborative work among different stakeholders. The collaborative nature of informing science theory applies to producing valuable input, which enhances workforce capacity (Martin et al., 2022).

HIPAA guidance on telehealth and remote use of technology was introduced by the OCR at the Department of HHS, enabling cross-disciplinary consultations (Cardile et al., 2023). This relaxation of enforcement discretion allows healthcare providers to use digital communication without incurring penalties (Russell et al., 2022). Integrating hospital AI models represents a new paradigm in medical information collection, challenging traditional methods (Rojek et al., 2024). However, the diverse state-level regulations for various healthcare professionals create transdisciplinary issues and varied approaches to care delivery.
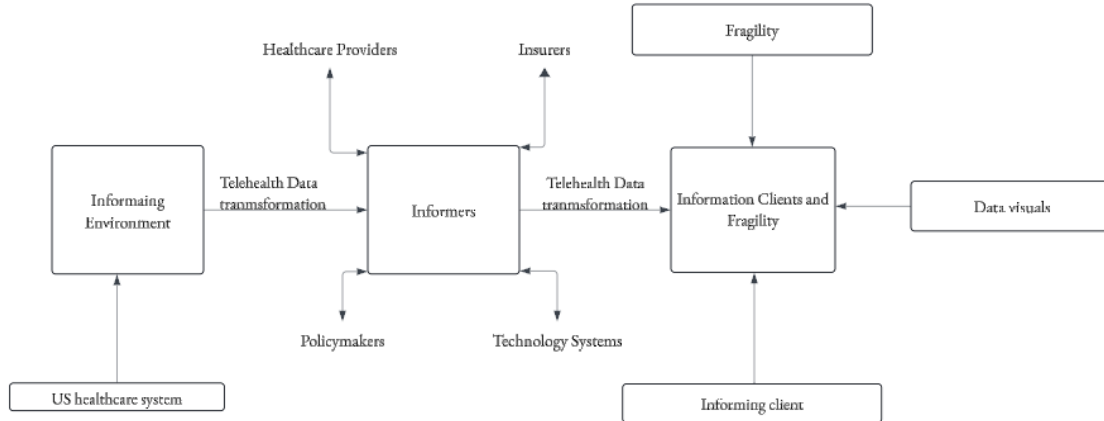
INFORMING SCIENCE CONCEPTS

In 1981, T. D. Wilson developed the informing science framework as a special instance that draws from various disciplines (Cohen, 2009). The revised informing science conduit framework model is applied to a healthcare delivery transdisciplinary context in the U.S. Figure 1 explains how the U.S. healthcare system collaborates with different disciplinary knowledge among patients, providers, and policymakers. It expands the contextual environment of information transmission from the informer and receiver from different disciplinary backgrounds (Martin et al., 2022). Providers send patient information to insurers, policymakers, and patients from various disciplinary knowledge bases.

Healthcare providers enable consultations, monitor patients' health activities, and collaborate with other knowledgeable professionals through telehealth platforms (Wosik et al., 2020). The information is transmitted electronically as HIEs, enhances care coordination, and allows for effective continuous patient monitoring. Fragilities and operations are influenced by social and ethical implications (Cohen, 2009). Figure 1 highlights the interactions between different stakeholders and the channels, modeling the layers of complexity in how information flows within the US healthcare system.

Figure 1. Conceptual diagram of informing science framework for informing environment

The informing science approach examines healthcare providers and patients within the context of health information exchange, tasks, and inherent limitations (Paraschiv et al., 2021). This framework acknowledges cognitive limitations and behavioral issues in processing complex medical information, particularly for patients with multiple health complications. Providers may experience decision fatigue due to rapid information processing, potentially leading to bias (Elendu et al., 2023).

Providers are increasingly utilizing AI tools, such as EHRs, that highlight critical information to manage cognitive overload. The healthcare sector is also witnessing strong digital momentum, with increased use of wearable health devices like Dexcom, fitness trackers, and continuous glucose monitors. These tools provide reminders and track health metrics, with providers recommending their use to design better information systems that support patient needs (Taylor & Pagliari, 2018).

Addressing individual biases and fragility in information processing can optimize communication and improve technological systems for better data transmission and security (Rojek et al., 2024). This approach exemplifies a transdisciplinary focus, integrating knowledge from health science, behavioral science, social science, and information technology.

U.S. HEALTHCARE STAKEHOLDER ECOSYSTEM

Figure 2 visually represents the key stakeholders in the U.S. healthcare system, with the patient at the center. It illustrates how various entities, such as healthcare providers, insurance companies, government agencies, medical education institutions, policymakers, and health IT systems, interact with and influence the patient's healthcare experience. Figure 2 vividly illustrates several crucial aspects of modern healthcare systems. At its core, it highlights patient-centricity, placing the patient at the center to underscore the importance of patient-centered care. This focus on the patient is linked by interconnectedness, showing how various stakeholders – providers, insurers, and policymakers – are all linked to the patient and play integral roles in the healthcare experience. The diagram also conveys the complexity of the healthcare system, with its multiple connections emphasizing the necessity for effective information flow among all parties involved. It also illustrates policy influence by incorpo-

rating policymakers, highlighting how regulations and legislation can impact the entire healthcare ecosystem. The role of technology **is** represented by the health IT stakeholder, who underlines the increasing significance of technology in healthcare delivery and information management.
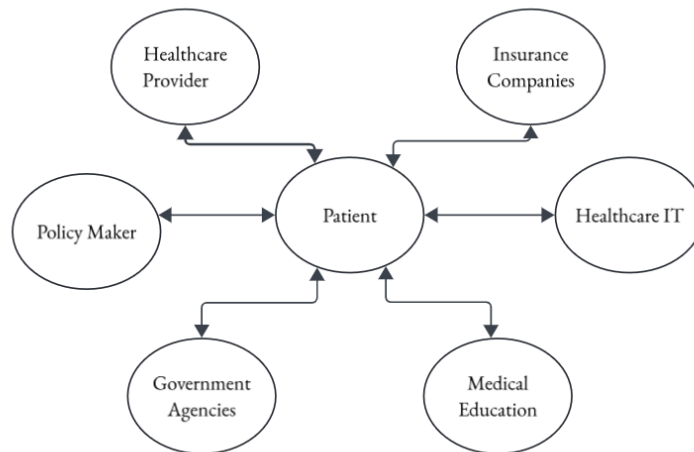
Figure 2. Diagram of healthcare information environment

Figure 2 can be referenced in various contexts throughout the paper. For example, it can help explain how policy changes, such as the ACA, affect multiple stakeholders. It is also useful when discussing the adoption of EHRs and their role in facilitating information flow between providers, patients, and insurers (Dodini, 2022). The diagram is relevant in addressing challenges in healthcare delivery, such as information asymmetry or communication barriers. Lastly, it can illustrate the need for a transdisciplinary approach in tackling healthcare challenges, as effective improvements often necessitate coordination among various stakeholders.

METHODOLOGY

This study employs a mixed-methods approach to analyze the evolution of U.S. healthcare delivery, combining qualitative analysis of policy documents and literature with quantitative analysis of healthcare data. The research aims to study quality outcomes through evolutionary changes in the U.S. healthcare system, applying informing science frameworks such as Cohen's (2009) "informing environment" concept to analyze the evolution of informing processes in healthcare.

The literature review covers U.S. healthcare from 1965 to 2024, including the creation of Medicare and Medicaid, and spans major policy changes, technological advancements, and healthcare delivery shifts. It includes peer-reviewed academic articles, government policy documents, and reports from healthcare organizations. The review focuses on four fundamental areas: policy development, including major healthcare legislation like the ACA and HIPAA, and regulatory changes; technological advancements such as the evolution of Electronic Health Records (EHRs), telemedicine, and AI in healthcare; healthcare quality, with emphasis on patient outcomes, quality improvement, and value-based care models; and informing processes, covering information flow among stakeholders, health data exchange systems, and patient privacy and security measures. The review uses sources such as PubMed, JSTOR, CMS, and HHS, ensuring a comprehensive understanding of U.S. healthcare's evolution and future trends.

KEY CONCEPT

Value-based care is a healthcare delivery model in which providers and physicians are paid according to patient outcomes, contrasting with the traditional FFS model (Folse et al., 2024). The value-based care model emphasizes the quality and efficiency of care rather than the quantity of services rendered. The key principles of value-based care are Quality, Patient-Centered Care, Preventive Care, Care Coordination, and Cost Efficiency (Cooper et al., 2024).

The research review on the economy of healthcare in transdisciplinary characteristics encompasses a range of studies that highlight collaboration, resulting in improved healthcare outcomes while managing costs efficiently. Studies such as those by Sibilla and Kurul (2020) emphasize the significance of transdisciplinary approaches in areas like energy retrofit, showcasing the benefits of collaborative efforts. Additionally, research by Martin et al. (2022) and Mokiy and Lukyanova (2022) further supports the notion that transdisciplinary approaches can enhance efficiency and cost-effectiveness in healthcare settings.

The complexity of the U.S. healthcare delivery industry as a transdisciplinary adaptive system necessitates innovative methods to identify efficient team structures using real-world care delivery data from EHRs (Tu et al., 2024). Informing science theory provides a framework where input, throughput, and output factors interact with clients and informers by passing information, emphasizing the importance of understanding healthcare delivery dynamics (Winslow et al., 2019). The learning healthcare system leverages AI technology with HIT to apply scientific evidence at the point of care, promoting innovation in healthcare delivery and scientific discovery (Maddox et al., 2017). The review by Chakrabarti (2019) on telemedicine and teledermatology demonstrates how healthcare delivery systems can offer cost-effective solutions from different disciplines without compromising quality (Araja et al., 2023).

Delivery science, also known as implementation science, aims to translate clinical research evidence into effective clinical care (Schmittdiel & Grant, 2018). By integrating technology and data science, healthcare decision-makers can enhance care delivery effectiveness and patient safety (Schmittdiel & Grant, 2018). The application of healthcare delivery science has shown promise in improving emergency department efficiency and overall healthcare service delivery (Samadbeik et al., 2024).

HEALTHCARE QUALITY AND EFFICACY

The CMS has introduced Value-Based Purchasing (VBP) programs to deliver high-quality care to hospitals and other healthcare providers (Devkaran et al., 2019). For example, the Hospital VBP program evaluates quality measures, including patient outcomes and satisfaction. Medicaid has also adopted VBP, incentivizing providers to focus on quality care (Kadakia & Offodile, 2023). Adjustments have been made to Medicare trust funds while introducing reforms to strengthen financial stability and preserve and protect the country's healthcare system. For example, increasing payroll taxes and focusing on the program's long-term financial health are some adjustments made to improve quality care (Hale et al., 2024). Cost control is another quality improvement method introduced to reduce fraud and negotiate drug costs for older adults, potentially saving them thousands of dollars. Setting spending caps helps reduce the waste of Medicare funds (Johnson et al., 2020). The introduction of pay-for-performance initiatives, such as the Merit-Based Incentive Payment System, provides incentives to improve care through performance measures (Katirai, 2023). Pay-for-performance reimbursement rates have increased nationwide for Medicaid quality care delivery (Lara-Millán & Ruppel, 2024).

POLICY AND REGULATORY DEVELOPMENT

Ongoing policy and regulatory developments will continue to shape the healthcare landscape. Issues like drug pricing, healthcare workforce shortages, and Medicare and Medicaid sustainability will likely be focal points of future reforms (Folse et al., 2024). Additionally, the evolving regulatory environment for digital health technologies will impact their adoption and use.

To enhance healthcare quality, accessibility, and efficiency, the U.S. healthcare system has significantly promoted digital health technologies (Rojek et al., 2024). The 21st Century Cures Act accelerated medical innovation by introducing a seamless health information exchange between healthcare providers and patients (Sendak et al., 2024). The Act stipulates that:

1. Health IT should follow interoperability and information-blocking rules (Razzak et al., 2019).
2. Provisions are in place against information blocking, ensuring that patients and providers can access and share electronic health information across different health systems (Razzak et al., 2019).

FINDINGS

HIPAA was introduced to enhance patient privacy and security and to protect against data breaches by increasing accountability and encouraging stronger data security. HIPAA focuses on developing standard electronic formats for health information transactions, reducing administrative burdens, and improving efficiency in patient care. Table 1 shows the results after HIPAA improvements and the results of HIPAA improvements after 1996.

Table 1. Post HIPAA improvement

Aspect	HIPAA (Post-1996)	Improvement/Effect	Reference
Patient Privacy	National standards for protecting patient privacy and confidentiality.	Enhanced patient privacy and reduced unauthorized access to patient health information.	(Ehizogie et al., 2024)
Data Privacy	Strong security rules for safeguarding EHR (e.g., encryption, access controls)	Improved data security and protection against breaches and unauthorized access.	(Reilly et al., 2018)
HIE	Standardized formats and protocols for exchanging health information electronically.	Reducing delays and improving care coordination.	(Sendak et al., 2024)
Administrative Efficiency	EHRs adoption encouraged	Reduced administrative burden and increased patient information managing efficiency	(Hale et al., 2024)
Compliance Costs	Structured compliance requirements and regular audits.	Improved standardization and legal protection.	(Eppes et al., 2023)
Patient Control	Patients have the right to access, correct, and obtain copies of their health records.	Empowered patients with greater control over health information.	(Kasula, 2021)
Reporting and Accountability	Mandatory reporting of privacy breaches and penalties for non-compliance.	Increased accountability for healthcare providers and more rigorous enforcement of privacy rules.	(Elendu et al., 2023)
Patient Trust	Enhanced trust due to stringent privacy and security standards.	Increased patient certainty in the security and confidentiality of EHRs	(Carroll et al., 2024)

Table 2 shows the observed value of insurance coverage rate increases with significant policy updates such as the introduction of Medicare and Medicaid, Health Maintenance Organization (HMO),

HIPAA, Balanced Budget Act (BBA), MMA, and the ACA. Similarly, healthcare costs per capita increase over time, with significant jumps in insurance coverage (Hale et al., 2024) after major policy implementations. In Table 2, we can also see the positive increment in life expectancy, which shows that the quality of patient care increased, particularly following key healthcare reforms.

Table 2. U.S. healthcare policy updates have helped patients over the years

Year	Insurance coverage rate (%)	Healthcare costs per capita ($)	Life expectancy (years)	Significant policy updates
1965	70	200	70.1	Medicare and Medicaid
1973	80	300	71.2	HMO
1996	85	1000	75.4	HIPPA
1997	86	1050	75.7	BBA
2003	87	1500	77.0	MMA
2010	89	2000	78.7	ACA
2014	90	2500	79.1	Medicare Access and CHIP Reauthorization Act

As shown in the diagram in Figure 3, EHR adoption rates increased due to the HITECH Act and Medicare and Medicaid EHR Incentive Programs (Kanakubo & Kharrazi, 2019). Centralized patient data has improved coordination among healthcare providers, reducing medical errors and ensuring patients receive consistent and accurate care.

During the COVID-19 pandemic, telehealth practices increased, and in-person visits to healthcare facilities decreased to minimize virus transmission (Gonzalez et al., 2024). Diagnostic Image Utilization (DIU) rates are constantly increasing due to AI technology. Healthcare facilities are increasing the usage of DIU to benefit from more accurate results of Magnetic Resonance Imaging (MRI), Computed Tomography Scan, and ultrasound records (Song et al., 2023).

HIE participation increased due to the ACA incentives for healthcare providers to adopt EHRs (Yelton & Schoener, 2020). Wearable device adoption is increasing slowly compared to other health technology parameters (Ge et al., 2023). As part of technological advancement, people are experiencing preventive care by monitoring vital signs, detecting irregular patterns, and managing chronic conditions like diabetes and heart disease (Rojek et al., 2024).
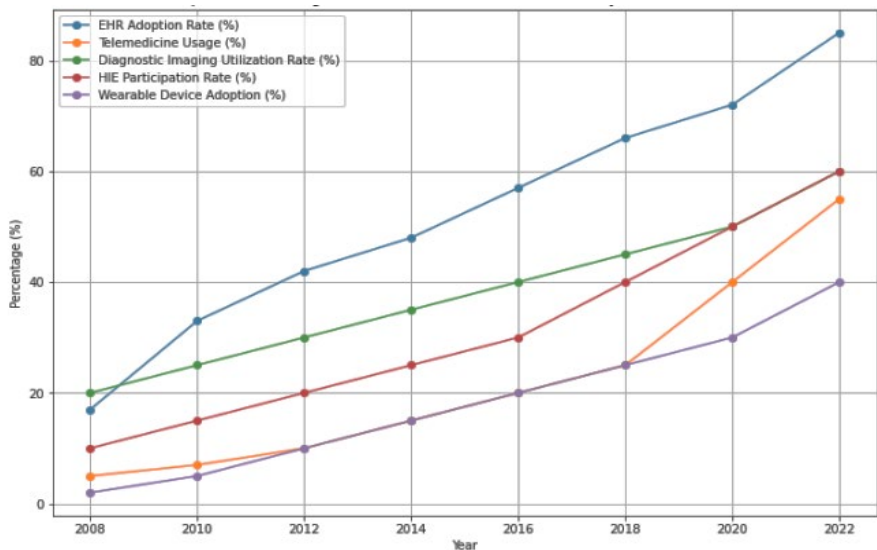
Figure 3. Impact of technology advancements on U.S. healthcare system effectiveness

Health IT expands patient satisfaction and reduces errors (Larsson et al., 2019). According to Kadakia and Offodile (2023), the shift toward value-based care has led to positive patient outcomes in health facilities. Hospitals are reducing readmission rates while improving health facility quality and service through financial penalties tied to performance metrics (Devkaran et al., 2019). According to Nakao et al. (2021), hospitals have increased rewards for preventive care services as part of quality improvement, promoted wellness programs and screenings, and avoided costly readmissions in the past five years. Chronic disease outcomes have improved in the past five years through access to remote monitoring. Patients are showing an increased interest in vaccinations, and lifestyle modifications have helped prevent chronic diseases, as discussed in Paraschiv et al. (2021). Figure 4 shows the trend of healthcare improvements in quality of services.
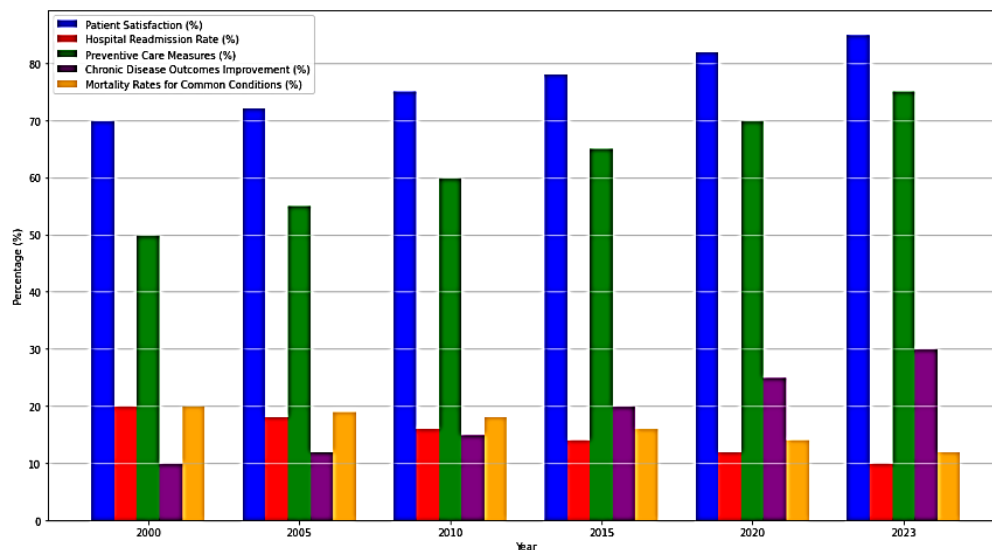

Figure 4. Healthcare improvements in quality of services

DISCUSSION

We have reviewed a wide range of research about changes in U.S. healthcare delivery. We used the idea of informing science to analyze how information sharing in healthcare has evolved. By looking at healthcare delivery from this broad perspective, we hope to understand complex information-sharing environments better. This could provide insights into the challenges and opportunities in evolving healthcare systems. It is crucial to introduce key informing science concepts to strengthen the theoretical framework. For instance, Cohen's (2009) concept of the "informing environment" highlights that the interaction between information and communication within academic communities is vital for developing a comprehensive knowledge map of the field (Wosik et al., 2020). The systematic concept of a knowledge map focuses on data, information, and knowledge. One of the characteristics of cross-disciplinary research is epistemological differences in evaluation metrics, and variation in paradigms can lead to disagreements on approaches and interpretations (Robertson et al., 2023). The concept of the informing science framework plays a significant role in explaining epistemological assumptions and guiding research methodologies within information science discourse.

The systems thinking approach underscores the importance of transdisciplinary collaboration in healthcare. Our analysis shows that effective healthcare delivery requires integrating knowledge from various fields, including medicine, information technology, policy, and economics. This perspective helps explain why many well-intentioned healthcare reforms and technological innovations have had unforeseen consequences or limited success (Pidd et al., 1996). For instance, the implementation of

EHRs was intended to solve the "puzzle" of efficient information storage and retrieval. However, it created new "problems" related to data privacy, interoperability, and physician burnout. This illustrates how solutions to individual puzzles within the healthcare system can create or exacerbate other problems due to the interconnected nature of the system. The U.S. healthcare delivery system is often described as a "complex mess" due to its multifaceted and fragmented structure, resulting in inefficiencies, high costs, and unequal access to care. Figure 5 highlights several interrelated issues.
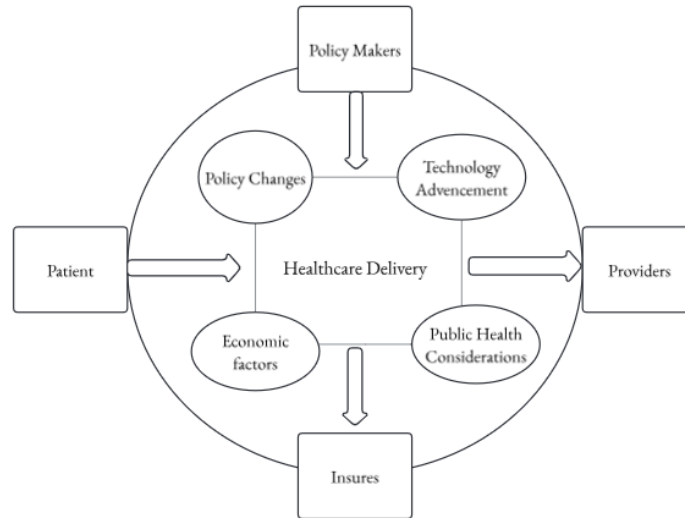
Figure 5. U.S. healthcare delivery system as a 'complex mess'

Changes in healthcare delivery have significantly impacted the flow of information among patients, providers, insurers, and policymakers. The evolution of U.S. healthcare systems into a complex collaboration of different healthcare professional adaptive systems has been instrumental in understanding the behavior of healthcare teams (Pype et al., 2018). This complex informing science framework has provided insights into how different knowledge backgrounds interact and function within the healthcare environment. Additionally, the concept of resilience in healthcare has emerged with technology, focusing on the system's capacity to adapt to challenges and changes to maintain high-quality care (Fagerdal et al., 2022; Guise et al., 2021). Research in U.S. healthcare delves into how systems, patients, and providers cope with various disruptions and changes to ensure the continuity and quality of care (Fagerdal et al., 2022).

Technological advancements have played a crucial role in improving the information processes within the healthcare system, leading to faster processing of patient data. For instance, integrating diverse knowledge management practices into healthcare governance has enhanced efficiency, transparency, and accountability (Frascarelli et al., 2023). Moreover, advanced AI technologies, including big data cloud-based systems, have transformed the gathering and analysis of personal health data on a large scale (Arava & Lingamgunta, 2020). These technological tools have facilitated the collection, storage, and analysis of vast amounts of real-time patient health information, thereby improving decision-making processes and patient outcomes.

Furthermore, the involvement of providers and policymakers in healthcare processes has been highlighted as essential for building patient-focused systems (Schroeder et al., 2022). Collaboration among multiple stakeholders has been advocated to deliver interventions tailored to patient experiences and address their needs (Schroeder et al., 2022). Applying the informing science theory of information passageway to clients among stakeholders is crucial for optimizing healthcare delivery and ensuring seamless coordination (Hybinette et al., 2023).

Reducing healthcare disparities remains a critical challenge (Boyce et al., 2024). Efforts to improve access to care for underserved populations, address systemic biases, and promote health equity are ongoing (Larsson et al., 2019). Initiatives such as community health programs and policy reforms can create a more inclusive and equitable healthcare system. The emergence of big data analytic algorithms may inherit bias from historical data (Udegbe et al., 2024). Consequently, the decision-making process and results may lead to healthcare disparities. Ensuring that machine learning algorithms are trained on diverse and representative data is crucial for minimizing bias (Song et al., 2023). Healthcare disparities and outcomes among marginalized communities worsened during the pandemic.

A multifaceted policy change approach is required in healthcare, involving community engagement, technological innovation, and improvements in delivery (Folse et al., 2024). Doctors can play a pivotal role in alleviating poor living conditions by implementing collaborative care models or establishing lower-income task forces to reduce hospital readmissions and ensure adequate healing time for lower-income patients upon discharge (Udegbe et al., 2024). An interdisciplinary approach involving collaboration among various sectors is essential for providing optimal care to lower-income individuals and addressing healthcare disparities (Ehizogie et al., 2024).

Several strategies are available to tackle healthcare disparities:

1. advocating policies to expand Medicaid healthcare access and public health programs to promote universal coverage (Dickens et al., 2022), and
2. improving the reimbursement model to offer high-quality care to all patients (Johnson et al., 2020).

Ongoing policy and regulatory developments will continue to shape the healthcare landscape. Key issues include drug pricing, healthcare workforce shortages, and Medicare and Medicaid sustainability. Additionally, the evolving regulatory environment for digital health technologies will impact their adoption and use (Folse et al., 2024).

EMERGING TRENDS AND CHALLENGES

Healthcare delivery in the U.S. faces several emerging trends and challenges that impact the quality and efficiency of the system. One of the identified challenges is the asymmetric distribution of information between healthcare providers and patients. This gap leads to delayed diagnoses, poor health outcomes, and diminished trust in providers and stakeholders. Additionally, there are difficulties in integrating healthcare systems and achieving interoperability of health information, including issues related to health data complexity, security, and standardization (Sigwele et al., 2018).

Communication barriers between patients and stakeholders exacerbate challenges in healthcare collaboration. Insufficient information exchange, inconsistent communication, varied use of HIT systems, and inadequate coordination have been identified as key issues (Wong et al., 2019). Furthermore, disparities in healthcare utilization among diverse cultural populations, including racial disparities, can lead to mistrust, misunderstandings, and conflicting cultural beliefs that influence how individuals interact with the healthcare system (MacPherson & Pham, 2020).

Efforts to address these challenges include leveraging advanced technologies like blockchain and AI to enhance healthcare systems. Blockchain technology helps manage healthcare supply chain processes effectively, while AI plays a significant role in automating EHRs to improve the quality of care delivered to patients (Ehizogie et al., 2024). Furthermore, blockchain technology simplifies complex medical procedures during decentralization, addresses challenges related to large-scale data management, and optimizes costs (Herr et al., 2018).

TECHNOLOGY IMPACTING U.S. HEALTH CARE

Digital health solutions became a trend during the pandemic. Growth in telemedicine, healthcare applications, symptom checkers, and information portals has emerged as a response to contactless

healthcare needs (Larsson et al., 2019). However, improving patient data privacy, security, and symptom detection accuracy using emerging AI technologies remains challenging. Enhancing collaboration to improve healthcare delivery and address these challenges is essential. Introducing neural networks and computer vision technologies can build trustworthiness among providers. These emerging technologies have increased home-based healthcare services, minimized hospital visits, and reduced virus exposure (Alan et al., 2024). However, concerns arise regarding healthcare quality and managing complex medical conditions outside traditional clinical settings (Ge et al., 2023). This emerging trend has led to lower costs and increased availability based on intelligent sensing. Privacy and security remain significant challenges, particularly in Wi-Fi passive sensing technology, which can be threatened by human actions (Cath, 2018). During March-April 2021, people with at least one disability were more likely to be offered telehealth appointments compared to those without disabilities (Regan, 2022). As shown in Figure 4, there has been tremendous growth in telehealth service preference, according to HHS.gov data. We suggest that qualitative research can inform theory development to address health equity and eliminate disparities within the healthcare system (Posinasetty & Yadav, 2023).

During the COVID-19 pandemic, the CMS expanded telehealth service coverage to deliver more health services remotely, aiming to minimize physical contact and ensure payment parity with in-person visits (Cardile et al., 2023). These changes increased the adoption of telehealth, which became more accessible during the pandemic. The expanded use of telehealth has continued under permanent policy changes, even in post-pandemic situations (Nguyen et al., 2023).

Additionally, the OCR at the Department of HHS introduced guidance on telehealth and remote use of technology under HIPAA during the COVID-19 pandemic (Ehizogie et al., 2024). This relaxation of enforcement discretion allowed healthcare providers to use digital communication without incurring penalties (Elendu et al., 2023).

The Medicare changes include:

- Federal Qualified Health Centers and Rural Health Centers can serve as distant site providers for non-behavioral/mental telehealth services.
- Medicare patients can receive telehealth services at home.
- Behavioral/mental telehealth services can be implemented without geographic restrictions.
- Audio-only communication can be used for non-behavioral/mental services.
- Rural Emergency Hospitals (REHs) are eligible for telehealth.

Figure 6 shows the qualified telehealth service enrollment among REHs, with increased telehealth services after the COVID-19 pandemic.
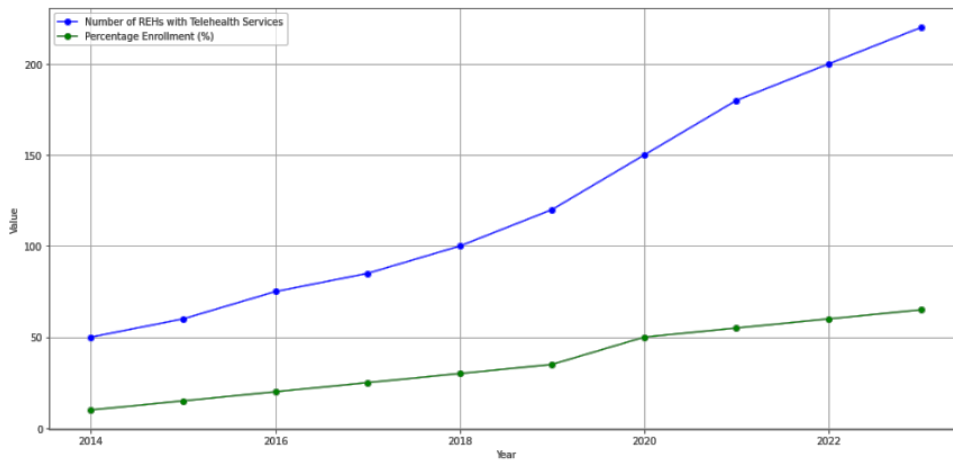

Figure 6. Telehealth service enrollment among REHs

HIT has revolutionized healthcare delivery, improving patient care coordination, reducing errors, and addressing health disparities (Graham et al., 2019; Larsson et al., 2019). EHRs, telemedicine, and wearable devices have enhanced patient engagement and facilitated remote monitoring. Modern technology has increased the accessibility of healthcare services, enabling organizations to reach any location and improve efficiency (Larsson et al., 2019). However, implementing advanced technologies can be challenging for patients and healthcare providers (Thakur & Hossain, 2023). Factors such as a limited understanding of healthcare supply chain management and industry regulations influence service delivery processes.

EHRs digitalize patient records, allowing faster access to information and better coordination among providers (Carvalho et al., 2024). AI devices provide more accurate reporting and improved patient safety. However, data privacy and security concerns affect the adoption of EHRs, telemedicine platforms, and health apps (Reilly et al., 2018).

Technological innovations must comply with HIPAA requirements, including data encryption and secure authentication mechanisms (Wilson-Nash et al., 2024). The rapid increase in EHR adoption rates between 2008 and 2014 can be attributed to the HITECH Act, which provided financial incentives for healthcare providers to adopt certified EHR technology (Kanakubo & Kharrazi, 2019; Kruse & Beane, 2018). Figure 7 highlights the EHR adoption rate in U.S. hospitals from 2008 to 2014.
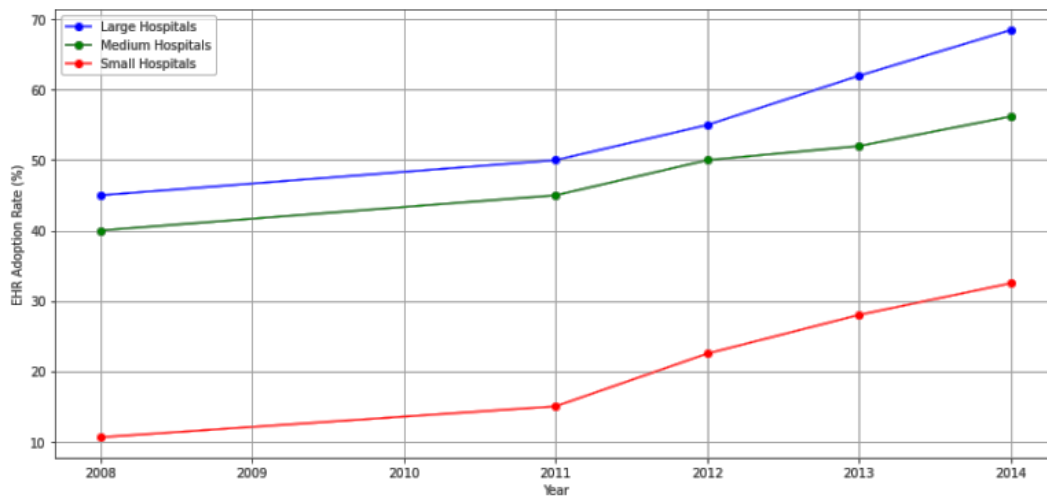
Figure 7. EHR adoption rate in U.S. hospitals from Year 2008 to 2014

Technology adoption and prevention

Health informatics integrates knowledge from biomedical sciences, computer sciences, and healthcare policy to modernize information processing and communication in healthcare (Razzak et al., 2019). Modern technology enables affordable personalized treatment plans based on genetic predispositions (Thakur & Hossain, 2023), while AI and machine learning algorithms analyze patient data to predict health outcomes (Frascarelli et al., 2023). Advancements in genomic sequencing technology, particularly AI initiatives in clinical care, have significantly improved cancer cell identification and treatment (Larsson et al., 2019).

The dynamic nature of healthcare-informing environments necessitates adaptive, flexible systems responding to evolving healthcare delivery needs. Key concepts in genomics include genetic variation and gene expression, which explain how environmental factors influence DNA and affect human health (Frascarelli et al., 2023). Bioinformatics software applications and genetic data integration are crucial for identifying potential therapeutic targets (Elendu et al., 2023).

Leveraging big data in genomics enables treatment planning based on genetic patient profiles (Kasula, 2021). The proliferation of wearable Internet of Things devices has led to comprehensive changes in healthcare, particularly in real-time monitoring (Larsson et al., 2019). Integrating big data with remote patient monitoring can detect early signs of heart disease and diabetes, potentially improving long-term health outcomes (Razzak et al., 2019). While initially expensive, AI technology can reduce healthcare costs by providing preventive health warnings (Nguyen et al., 2023).

Transdisciplinary approach

Transdisciplinary approaches in healthcare have demonstrated their effectiveness by enhancing patient care and outcomes across various settings. One prominent example is the collaborative care model for chronic disease management, where a diverse team of healthcare professionals, including physicians, nurses, social workers, and pharmacists, work together to address the multifaceted needs of patients with chronic conditions. For instance, in managing diabetes, endocrinologists collaborate with nutritionists, physical therapists, and mental health professionals to develop comprehensive treatment plans that address the patient's health and health's physical and emotional aspects (Wickman et al., 2021).

Geriatric assessment units are another successful implementation of transdisciplinary care (Samadbeik et al., 2024). These specialized units bring together geriatricians, neurologists, psychiatrists, physical therapists, and social workers to provide thorough care for elderly patients with multiple comorbidities. This collaborative approach effectively manages the complex health needs of aging populations, ensuring that all aspects of their care are addressed (Cardile et al., 2023).

A transdisciplinary approach is used in pediatric developmental centers to assess and treat children with developmental disorders (Aarons et al., 2019). Pediatricians work alongside speech therapists, occupational therapists, psychologists, and special educators to address all facets of a child's development. This comprehensive approach ensures that each child receives well-rounded care considering their developmental, educational, and psychological needs. The rise of digital health and telemedicine further underscores the importance of transdisciplinary collaboration (Araja et al., 2023). Integrating digital health technologies and telemedicine necessitates cooperation among healthcare providers, IT specialists, user experience designers, and data security experts. Transdisciplinary teams ensure that these technologies are implemented effectively and securely while maintaining high standards of patient care.

Emerging transdisciplinary

The landscape of healthcare delivery is evolving into an interdisciplinary field that integrates AI technology, policy updates, and clinical practice to reshape healthcare processes continuously. Implementing EHRs, telemedicine, AI, and the Internet of Medical Things (IoMT) revolutionizes healthcare delivery (Yelton & Schoener, 2020). Moreover, advanced AI technologies, including big data cloud-based systems, have transformed the gathering and analysis of personal health data on a large scale (Arava & Lingamgunta, 2020). Additionally, integrating these technologies has facilitated the collection, storage, and analysis of vast amounts of real-time patient health information, thereby improving decision-making processes and patient outcomes (Ehizogie et al., 2024; Wong et al., 2019).

QUALITY OF SERVICES

The U.S. healthcare system faces a persistent challenge. Despite spending a higher proportion of its GDP on healthcare than other developed nations, it fails to achieve commensurate improvements in care quality or health outcomes (Kadakia & Offodile, 2023). The COVID-19 pandemic exacerbated this issue, with national health expenditures surpassing $4.3 trillion in 2021 and projected to reach $6.3 trillion by 2030 (Ehizogie et al., 2024; Kadakia & Offodile, 2023).

In response, the Affordable Care Act (ACA) of 2010 introduced payment policies to reduce costs and enhance healthcare quality (Hale et al., 2024). This initiative prioritized a shift from the fee-for-

service (FFS) model to alternative payment models (APMs) that link reimbursement to quality outcomes (Nguyen et al., 2023).

However, preventive care access remains unequal, particularly for underserved communities, leading to health outcome disparities (Bowser et al., 2024). Socioeconomic, geographic, cultural, and linguistic barriers contribute to this inequity, with systemic obstacles hindering healthcare service navigation, especially for those with limited resources or system familiarity (Guo et al., 2022; Kasula, 2021).

Regulatory frameworks and cost control

The U.S. government introduced the Certificate of Need process in 1974, requiring states to obtain approval before expanding or constructing new medical facilities to reduce service duplication and control healthcare costs (Chiu, 2021; Mitchell, 2024). The Emergency Medical Treatment and Labor Act (EMTALA) mandates that hospitals with emergency departments evaluate any individual seeking treatment, regardless of their insurance status or ability to pay, to determine if an emergency medical condition exists (Rojek et al., 2024; Terp et al., 2017). If identified, hospitals must provide stabilizing treatment to prevent material deterioration before transfer or discharge. For patients in labor, treatment must continue until delivery.

EMTALA compliance ensures consistent quality of care regardless of a patient's financial situation (Eppes et al., 2023). Ongoing monitoring by CMS and other regulatory bodies helps maintain care standards (Hale et al., 2024). Additionally, regulation of health insurance companies and plans promotes fair practices, consumer protection, and market stability statewide.

CONCLUSION

This paper examines the development and implementation of transnational competencies in the U.S. healthcare system through a transdisciplinary approach. Adopting a transdisciplinary methodology can lead to innovative solutions for improving patient outcomes by integrating knowledge from various healthcare disciplines and collaborative teams (Liu et al., 2024). The evolutionary path of the U.S. healthcare system has embraced an interdisciplinary approach that strives toward delivering high-quality care within a financially sustainable framework. Our analysis reveals that effective healthcare delivery requires more than solving individual puzzles or addressing isolated problems. The evolutionary path of the U.S. healthcare system has embraced an interdisciplinary approach striving towards high-quality, financially sustainable care. We advocate for transdisciplinary collaboration to enhance innovation and sustainability in healthcare delivery. Our analysis and research findings support adopting transdisciplinary approaches to enhance collaboration, innovation, and sustainability in healthcare delivery.

Adopting AI systems and secure EHRs aligns with the core tenets of delivery science, allowing healthcare organizations to address the multifaceted requirements of individual patients and broader community health needs. The informing science framework provides a theoretical foundation for understanding how changes in healthcare delivery have influenced information flow among professionals (Khayal & Farid, 2018). At the same time, technological improvements have reshaped the information process within the system.

Developing communication skills illuminates cross-disciplinary competencies for emerging healthcare professionals in various regulatory fields. These skills address gaps in fostering transdisciplinary collaboration as a normative aspect of professional effectiveness. Future research should explore challenges surrounding health information complexity, communication, and healthcare disparities. By embracing the informing science perspective and systems thinking, we can work towards more effective, efficient, and equitable healthcare delivery that meets the needs of all stakeholders in this complex system.

GLOSSARY

ACA: Affordable Care Act - A comprehensive health care reform law enacted in March 2010, also known as Obamacare.

ACOs: Accountable Care Organizations - groups of doctors, hospitals, and other health care providers who voluntarily come together to provide coordinated, high-quality care to their Medicare patients.

AI: Artificial Intelligence - The simulation of human intelligence processes by machines, especially computer systems.

APM: Alternative Payment Model - A payment approach that gives added incentive payments to provide high-quality and cost-efficient care.

ARRA: American Recovery and Reinvestment Act - An economic stimulus package enacted in 2009 that included healthcare IT provisions.

BBA: Balanced Budget Act - A United States federal law enacted in 1997 designed to balance the federal budget by 2002.

CHIP: Children's Health Insurance Program - A program that provides health coverage to eligible children, through both Medicaid and separate CHIP programs.

CMS: Centers for Medicare and Medicaid Services - The federal agency that administers Medicare, Medicaid, and the Children's Health Insurance Program.

DIU: Diagnostic Image Utilization - The use of medical imaging techniques for diagnostic purposes.

EHR: Electronic Health Record - Digital version of a patient's paper chart, real-time, patient-centered records that make information available instantly and securely to authorized users.

EMTALA: Emergency Medical Treatment and Labor Act - A federal law that requires hospital emergency departments to medically screen every patient who seeks emergency care and to stabilize or transfer those with medical emergencies, regardless of health insurance status or ability to pay.

FFS: Fee-For-Service - A payment model where services are unbundled and paid for separately.

HIPAA: Health Insurance Portability and Accountability Act - A 1996 federal law that required creation of national standards to protect sensitive patient health information.

HIE: Health Information Exchange - The mobilization of healthcare information electronically across organizations within a region, community or hospital system.

HIT: Health Information Technology - refers to the electronic systems healthcare professionals (and sometimes patients) use to store, share, and analyze health information.

HITECH: Health Information Technology for Economic and Clinical Health Act - Part of the American Recovery and Reinvestment Act of 2009, was signed into law to promote the adoption and meaningful use of health information technology.

HMO: Health Maintenance Organization - A type of health insurance plan that usually limits coverage to care from doctors who work for or contract with the HMO.

IoMT: Internet of Medical Things - The collection of medical devices and applications that connect to healthcare IT systems through online computer networks.

MMA: Medicare Modernization Act - A 2003 law that added an outpatient prescription drug benefit to Medicare.

OCR: Office for Civil Rights - An agency of the U.S. Department of Health and Human Services responsible for enforcing certain regulations related to healthcare.

ONC: Office of the National Coordinator for Health Information Technology

REH: Rural Emergency Hospital - A new Medicare provider type established to address the growing concern over closures of rural hospitals.

VBP: Value-Based Purchasing - A concept by which purchasers of health care (government, employers, and consumers) hold the health care delivery system accountable for both quality and cost of care.

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