

Interdisciplinary Collaboration in Advancing Nursing Science: Opportunities, Challenges, and Future Directions

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ABSTRACT

Background:-Nursing science has evolved from its historical roots in caregiving to a discipline central to patient care, research, and health policy. Increasingly complex health challenges such as chronic diseases, aging populations, and global health disparities require solutions beyond the scope of a single profession. Interdisciplinary collaboration has therefore become essential, enabling nurses to work alongside physicians, public health experts, engineers, data scientists, and social scientists to advance healthcare innovation and improve outcomes.

Methodology:-This review critically examines the role of interdisciplinary collaboration in nursing science by exploring its historical development, theoretical foundations, key models of collaboration, drivers such as technology and policy, and its application across clinical practice, education, research, and global health. Literature spanning case studies, implementation models, and policy frameworks was synthesized to assess both opportunities and barriers.

Results:-Evidence shows that interdisciplinary collaboration improves patient-centered care, enhances research innovation, and strengthens health system resilience. Examples include nurse-led interdisciplinary teams in critical care, precision health research integrating genomics and informatics, and community-based public health initiatives. Collaborative education models such as interprofessional education (IPE) prepare future healthcare professionals for team-based practice. However, persistent challenges remain, including structural silos, role identity conflicts, power imbalances, communication barriers, and ethical complexities in collaborative research.

Conclusion:-Interdisciplinary collaboration is a transformative force in advancing nursing science, enabling innovation in research, technology integration, and health systems. Addressing challenges through leadership support, structured communication, shared decision-making, and policy reform will be essential to sustain collaboration. Future directions include leveraging AI, big data, and global partnerships to strengthen nursing science's role in improving health outcomes and equity worldwide.

Keywords: Interdisciplinary collaboration, Nursing science, Healthcare innovation, Patient-centred care, Interprofessional education, Research, Global health.

INTRODUCTION

Nursing science has evolved from its ancient roots in family care and religious orders to become a leading force in modern healthcare. Early history saw caregivers, often relatives or clergy, attend to the sick, while formalized nursing emerged with organizations like the Sisters of Charity in the 17th century. The seminal transformation occurred with Florence Nightingale during the Crimean War; her emphasis on hygiene, sanitation, and compassionate care revolutionized the profession and established standards for nursing education and practice.(1) Hospitals began instituting apprenticeship-style training programs in the late 19th and early 20th centuries, laying a foundation for both practical and theoretical advancement. Historically regarded as a female-dominated occupation, nursing gradually overcame gender stereotypes, welcoming increased diversity in the workforce. Today, nurses provide direct patient care, monitor health conditions, educate patients and families, collaborate in care planning, and advocate for patient rights and safety. Their responsibilities reach into legal documentation, complex procedures, and leadership roles within multidisciplinary healthcare teams.(2) The Advancements in nursing education have fueled the profession's growth, with most nurses now pursuing formal degrees across associate, bachelor's, master's, and doctoral levels. This academic rigor has led to the proliferation of nursing specialties like critical care, pediatric, psychiatric, and community health nursing. With rapid technological innovation, nurses adeptly use electronic health records, telemedicine platforms, and advanced medical devices to deliver efficient, high-quality care.(3) The shift toward patient-centered and evidence-based practice is coupled with an emphasis on interdisciplinary collaboration, positioning nurses as integral partners alongside physicians, therapists, pharmacists, and technologists in holistic care delivery. This breadth of expertise has enabled nurses to take on greater advocacy and leadership roles, influencing health policy and

promoting systemic change. On the front lines of global health challenges, including pandemics and health inequities, nurses use their expertise in infection control, education, and community outreach to shape public health initiatives. The Interdisciplinary collaboration in health sciences is now indispensable amid the complex and dynamic nature of contemporary healthcare. Chronic diseases, aging populations, emerging health threats, and healthcare disparities require solutions beyond the scope of any single discipline. Historically isolated by professional silos, nurses and their colleagues in medicine, public health, engineering, and social sciences are now called to integrate knowledge and skills. Nurses, with their holistic, patient-centric view, help drive innovation in teams structured for research, clinical work, policy making, and education.(4) Their unique perspectives enhance symptom management, care coordination, system improvements, and patient advocacy. Collaborative efforts have produced ground-breaking technologies, new care models, and comprehensive treatment strategies that address acute and chronic health needs. In research, interdisciplinary teams increase the rigor and relevance of findings, translating them into real-world healthcare improvements. Education that models collaborative practice prepares future nurse leaders and team members for adaptive, effective responses to the demands of complex patient populations.(5) As health systems strive for quality, equity, and accessibility, interdisciplinary collaboration is recognized as foundational for advancing nursing science and the broader health sciences.

This review critically examines the dynamic landscape of interdisciplinary collaboration in nursing science, with objectives that include exploring its historical evolution and present status, evaluating its potential and realized benefits, identifying persistent challenges and barriers, and outlining future directions for progress. The review aims to highlight the necessity of interdisciplinary collaboration for the continued evolution and impact of nursing science in contributing to global healthcare quality, equity, and innovation.

2. Conceptual and Theoretical Foundations

The conceptual and theoretical foundations of interdisciplinary collaboration in nursing science are anchored in key distinctions among multidisciplinary, interdisciplinary, and transdisciplinary approaches. In multidisciplinary work, professionals from different disciplines contribute their expertise to solve specific problems, yet each remains within the boundaries of their field. This approach adds value by integrating distinct perspectives without blending them into a unified whole. In contrast, interdisciplinarity represents the synthesis and harmonization of knowledge, analyzing and connecting disciplines into a cohesive and coordinated framework.(6) Interdisciplinary collaboration entails developing shared concepts, language, and goals to address complex phenomena that defy single-discipline solutions, especially in health science and nursing. Transdisciplinarity moves a step further, integrating natural, social, and health sciences—transcending traditional boundaries, and shaping holistic approaches that prioritize real-world relevance and stakeholder input.

In healthcare, these models create a continuum of involvement, with multidisciplinary work as additive, interdisciplinary as interactive, and transdisciplinary as holistic; each term reflects a unique depth of collaboration and should not be used interchangeably. The more general term "multiple disciplinary" is appropriate where the nature and degree of engagement from various disciplines are unspecified, and is particularly useful for describing teamwork that includes a range of professional and academic backgrounds united in purpose.(7) Theoretical frameworks underpinning collaboration in nursing science are increasingly rooted in complexity science and systems theory. Complexity science, particularly the Nursing Theory of Complex Adaptive Systems (NTCASs), recognizes that modern healthcare is dynamic, unpredictable, and interconnected. This paradigm replaces traditional linear models with approaches that emphasize adaptation, holistic understanding, and interdependence among system agents. Nurses applying complexity science understand patients as intricate, adaptive systems shaped by physical, psychological, social, and environmental factors.

Interprofessional collaboration, flexibility, and resilience are at the core, promoting adaptive care practices that respond to shifting patient and organizational needs.(8) Systems theory further asserts that healthcare organizations and teams behave as systems—networks of relationships, feedback loops, and interactions—where the whole is greater than the sum of its parts. Applying systems thinking empowers nursing teams to anticipate emergent phenomena, coordinate complex care, and integrate contributions from medicine, psychology, social work, and engineering. The practical implications of these frameworks include mobilizing flexible care strategies, fostering open communication, and creating environments conducive to shared learning and distributed leadership. Recent scholarship highlights not only the theoretical gaps in traditional nursing models but also the value of embracing complexity and systems thinking to address evolving healthcare demands, improve patient outcomes, and build resilient organizations.(9)

The historical evolution of interdisciplinary research in nursing reveals a trajectory defined by transformation, adaptation, and innovation. Rooted in the pioneering work of Florence Nightingale in the 19th century, nursing research originally focused on practical improvements in care, hygiene, and patient environments. The 20th century saw rapid growth in nursing science as education moved into university settings, and nurses increasingly collaborated with physicians, psychologists, statisticians, and policy experts to address acute and chronic health challenges. The establishment of organizations such as Sigma Theta Tau in 1936 marked a turning point, fostering rigorous inquiry and knowledge dissemination through conferences, journals, and academic networks. In the 1950s, federal support and the

first peer-reviewed nursing research journal propelled the profession's scientific grounding. The following decades unleashed a proliferation of clinical specialty journals, interdisciplinary research centers, and collaborative initiatives in heart and lung disease, geriatrics, pediatrics, and community health. Milestones such as the founding of the National Institute of Nursing Research in 1993 and the Annual Review of Nursing Research further solidified nursing science's role as a key contributor to multidisciplinary health solutions. The democratization of research and the emergence of data science, patient informatics, and global health priorities have expanded the reach and relevance of nursing research, strengthening its capacity to address disparities, promote equity, and foster innovation across health systems.(2) Today, interdisciplinary research is a vital force in nursing, enabling robust inquiry, practical solutions, and ongoing adaptation to the complexities of contemporary healthcare.

These conceptual and theoretical foundations emphasize how interdisciplinary collaboration has evolved—from disciplinary silos to a model deeply integrated with complexity science and systems theory—making nursing research and practice more adaptive, innovative, and impactful in advancing health outcomes and healthcare delivery.

3. Drivers of Interdisciplinary Collaboration in Nursing Science

Interdisciplinary collaboration in nursing science is driven by a constellation of pressing forces central to the evolution of healthcare delivery. First and foremost is the imperative of advancing patient-centered care. In an era where healthcare is increasingly personalized and holistic, nurses stand at the core of interdisciplinary teams that pool expertise from across disciplines to address not only biomedical needs but also the psychological, social, and environmental factors that influence patient well-being.(10) Collaboration enables teams to understand the whole person, moving beyond episodic or fragmented care to develop nuanced interventions, preventive strategies, and rehabilitative pathways. Such partnerships, for instance, unfold in accountable care organizations where physicians, nurses, and a range of specialists work collectively to orchestrate seamless, coordinated services, often resulting in lowered costs and improved patient outcomes in chronic disease management, acute care, and preventive efforts.

The complexity of health challenges further propels interdisciplinary collaboration as an essential feature of modern nursing practice. Chronic diseases, the aging population, mental health concerns, and emerging syndemics require solutions that no single discipline can adequately address. Nurses frequently find themselves in the vanguard of teams managing multiple comorbidities, high-acuity patients, social determinants of health, and rapidly shifting demographic needs. Interdisciplinary strategies are crucial for assembling the innovative knowledge and technologies from evidence-based medicine to social identity theory—that are necessary to tackle these multifaceted problems.(11) As health acuity, comorbidities, and demographic pressures surge, nurses benefit from collaborative partnerships with physicians, therapists, pharmacists, and social workers to collectively shape solutions and improve outcomes.

Healthcare innovation and technology integration serve as powerful drivers, reshaping the contours of nursing science and its collaborative environment. The integration of new technologies such as electronic health records, telemedicine, wearable sensors, and personalized medicine platforms necessitates strong interdisciplinary bonds. Nurses collaborate with engineers, data scientists, and informatics specialists to design, implement, and evaluate technology-driven interventions that optimize clinical workflow, patient safety, and quality of care.(12) The ongoing emergence of digital health tools, artificial intelligence, and advanced diagnostics further amplifies the need for interdisciplinary training and adaptation. Interdisciplinary teaching methodologies and team science expose nursing students and professionals to creativity, innovation, and rapid competency development, preparing them for a landscape where technology is not only pervasive but also transformative.

Policy and funding mandates increasingly institutionalize interdisciplinary collaboration, shaping the structure and focus of nursing research and practice. Healthcare systems and funding agencies recognize that interdisciplinary projects—particularly those with the potential to decrease costs and improve quality—are vital for achieving population health goals. Accountable care organizations and academic medical centers, for example, often mandate the formation of interdisciplinary teams in care planning, research, and quality improvement initiatives. Funding bodies, including the NIH and organizational partners, prioritize projects that leverage disciplinary breadth, require team science, and emphasize capacity building in collaborative skills, knowledge, and cultural competence. These mandates influence the content of nursing curricula, research goals, and workforce development, with professional preparation now centered on effective communication, shared goals, and adaptive teamwork.(13) Integrative research training and professional development aim to create a culture of interdisciplinary excellence, both to fill workforce gaps caused by retirements and to prepare new nurses for the collective problem-solving requirements of tomorrow's healthcare.

Patient-centered care and complex health challenges become increasingly prominent, interdisciplinary collaboration emerges not only as a strategic response but also as a defining feature of nursing science. Technology integration, policy initiatives, and funding priorities collectively drive the development of collaborative skills and the formation of scientific teams capable of achieving improved patient outcomes, innovative healthcare practices, and resilient health systems.(14) The culture of interdisciplinary collaboration is thus essential for preparing nurses to navigate and lead in the evolving landscape of contemporary healthcare

4. Models and Approaches to Collaboration

Models and approaches to collaboration in nursing science span a range of settings, disciplines, and educational frameworks, reflecting the complexity and diversity of healthcare teams. Central to research team models is the nurse-physician collaboration, which has been extensively studied due to its critical impact on patient outcomes and workplace satisfaction. Effective nurse-physician collaboration is characterized by mutual respect, shared decision-making, open communication, and clear leadership structures. One conceptual model in the Intensive Care Unit (ICU) context, based on Donabedian's Health Quality Model, outlines collaboration through three components: structure (e.g., accessibility, leadership, and team cohesion), process (e.g., advocacy, rounding, professionalism), and outcomes (patient outcomes, nurse and physician satisfaction).⁽¹⁵⁾ This model highlights that collaboration improves clinical decision-making and care quality while fostering a positive work environment among both nurses and physicians. The dynamic interaction between these components ensures that care is coordinated, adaptive, and patient-centered.

Beyond nurse-physician teams, collaboration between nurses and public health professionals is increasingly vital, especially in community health contexts. Studies from Japanese and Lithuanian healthcare settings demonstrate how public health nurses and general practitioners build strong, trust-based partnerships to address community health needs. These partnerships generate new perspectives on public health challenges and foster solidarity among professionals, which benefits residents by promoting proactive health behaviors and better health program outcomes.⁽¹⁶⁾ Public health nursing collaboration extends further into interprofessional teams composed of medicine, social work, and environmental health professionals, allowing shared expertise to create comprehensive interventions that address population health holistically. In particular, the leveraging of digital tools and data analytics enhances communication, coordination, and the efficiency of community health initiatives led by public health nurses.

Interprofessional education (IPE) and collaborative learning are foundational to preparing healthcare professionals for effective teamwork. IPE involves students from two or more professions learning about, from, and with each other to foster collaborative practice and improve health outcomes. It unfolds along a continuum with phases of exposure, immersion, and mastery. In the exposure phase, learners engage in common orientations and activities to build awareness and mutual respect.⁽¹⁷⁾ The immersion phase focuses on active collaborative interactions, role clarification, and ethical understanding through clinical exposure and team-based learning activities such as simulations and case discussions. The mastery phase involves applying critical thinking and problem-solving in complex care scenarios, such as mental health and chronic disease management. Effective IPE requires facilitators skilled not just in education but also in mediating conflicts, resolving misunderstandings, and nurturing communication, leadership, and teamwork skills essential for clinical practice.

Successful interdisciplinary research programs led by nurse scientists demonstrate how collaboration advances nursing science and addresses complex health issues. At the National Institute of Nursing Research (NINR), nurse-led teams comprise experts from biomedical engineering, neuropsychology, bioinformatics, and clinical medicine.⁽¹⁸⁾ These teams have developed innovative tools such as rapid diagnostic tests for infectious diseases and advanced biomarkers for cancer-related fatigue and traumatic brain injury. **(Figure 1)** Their work spans global health challenges and injury recovery, driving clinical interventions that reduce morbidity, improve diagnostics, and enhance therapeutic strategies. Nurse scientists' leadership in these teams underlines the vital role nursing plays not only in patient care but also in foundational health sciences research.

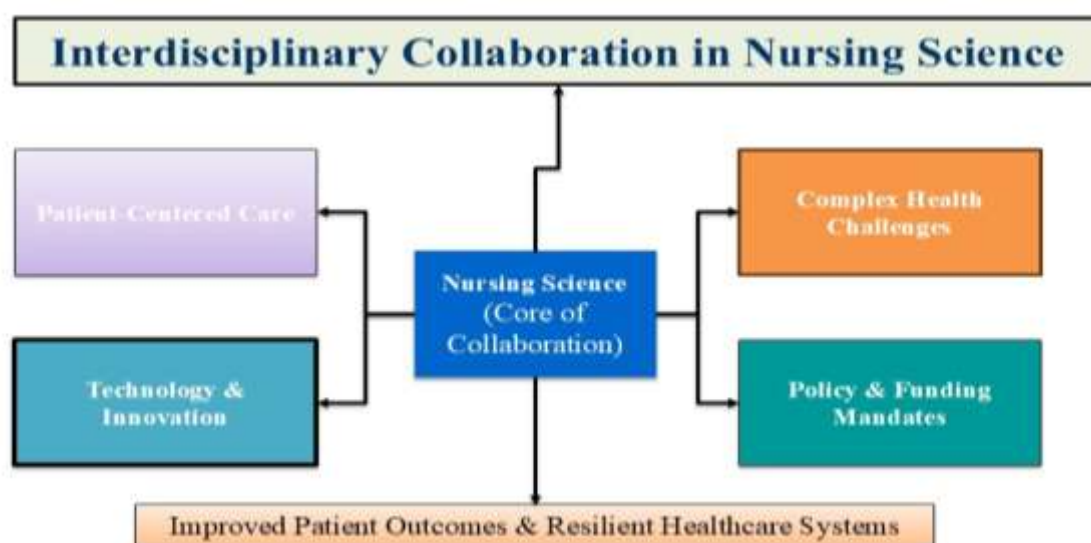


Figure 1: Interdisciplinary Collaboration in Nursing Science

Collaborative practice models extend across clinical, community, and global health environments to address diverse patient and population needs. Clinical models emphasize shared governance, clear role delineation, routine interdisciplinary meetings, and coordinated care planning, often centering on chronic disease and acute care management. Community models activate networks between health professionals and social agencies in both urban and rural areas to promote health surveillance, education, and rehabilitation, particularly for vulnerable populations such as the elderly or those with chronic illnesses.(19) Globally, collaborative practices are shaped by political frameworks that support interprofessional education, team-based care, and shared clinical pathways with common patient records. Case studies reveal nurses frequently serving as leaders and coordinators in collaborative teams addressing complex needs, from communicable disease control in India's primary health clinics to chronic disease management in Thailand(20). These models demonstrate how collaboration is embedded in health system function, optimizing patient outcomes, enhancing resource use, and fostering holistic care across diverse contexts.

Together, these models and approaches reveal that effective collaboration in nursing science depends on intentional structure, educational preparation, leadership, and inclusive practice environments. They underscore nursing's central role in bridging disciplines, fostering interconnected wisdom, and delivering integrated, patient-centered care in an increasingly complex global health landscape.

5. Key Areas Where Interdisciplinary Collaboration Has Advanced Nursing Science

Interdisciplinary collaboration has become a cornerstone in advancing nursing science across several critical domains, driving innovation, improving patient outcomes, and addressing the complexities of modern healthcare.(Table 1)

5.1.Clinical Research: Collaboration across disciplines has significantly enhanced clinical research in nursing, particularly in areas such as precision health, palliative care, and critical care. Precision health exemplifies how integrating genomics, bioinformatics, nursing knowledge, and clinical medicine enables personalized care approaches tailored to individual patients' genetic profiles and environmental contexts. Nurse scientists collaborate with biomedical engineers, geneticists, and physicians to develop biomarkers and targeted interventions, advancing early detection and treatment of diseases. In palliative care, interdisciplinary teams comprising nurses, physicians, social workers, and psychologists coordinate to manage complex symptoms, improve quality of life, and address psychosocial needs in seriously ill patients. Critical care research benefits from the synergy of nursing insights with respiratory therapy, pharmacology, and advanced technology fields, fostering innovations in patient monitoring, ventilator management, and infection control.(21) These collaborations have led to improved survival rates, symptom reduction, and holistic care models that emphasize dignity and patient autonomy.

5.2.Public and Community Health: Nursing's role in public and community health underscores the importance of interdisciplinary approaches for preventive interventions, health promotion, and addressing social determinants of health. Nurses work alongside epidemiologists, social workers, public health officials, and community organizers to design and implement programs targeting chronic disease prevention, vaccination campaigns, and health education. By integrating behavioral science and environmental health perspectives, nursing-led teams address socioeconomic factors such as poverty, education, housing, and access to care, which profoundly influence health outcomes.(22) Interdisciplinary collaboration enables comprehensive community assessments and policy advocacy initiatives that improve resource allocation and promote health equity. These efforts are critical in vulnerable populations, including racial and ethnic minorities, the elderly, and rural communities, where disparities in health persist despite advances in medical technology.

5.3.Technology and Innovation: The integration of digital health, artificial intelligence (AI), and telehealth represents a transformative frontier in nursing science enabled by interdisciplinary partnerships. Nurses collaborate with computer scientists, engineers, data analysts, and informaticians to develop and apply technologies that enhance patient assessment, remote monitoring, medication management, and predictive analytics. AI-powered tools assist nursing professionals by identifying clinical risks, recommending interventions, and automating documentation, thus improving efficiency and accuracy. Telehealth services expand access to care, particularly in underserved or geographically isolated areas, enabling nurses to deliver consultations, education, and follow-up care remotely.(23) These technological advances demand that nurses acquire digital literacy and participate in designing user-friendly solutions that meet clinical needs and ethical standards, fostering a collaborative culture of continuous innovation.

5.4.Policy and Health Systems Research: Nurses have increasingly played a pivotal role in shaping health policy, regulations, and quality improvement initiatives through interdisciplinary collaboration. Nursing researchers partner with health economists, policymakers, administrators, and legal experts to evaluate and redesign health systems for improved efficiency, cost-effectiveness, and patient safety. By leveraging their frontline clinical experience combined with data analysis skills, nurses advocate for policies that address workforce shortages, care coordination, and equitable access. Interdisciplinary health systems research explores evidence-based models such as accountable care organizations and patient-centered medical homes, where nursing contributions to team-based care, patient education, and chronic disease management are critical.(24) Collaborative policy efforts ensure that regulations reflect the realities of clinical practice and prioritize both provider well-being and patient outcomes.

Table 1: Interdisciplinary collaboration encompasses diverse models and settings

Study	Description	Disciplines Involved	Achievements/Outcomes	Reference
Precision Health Research at NINR	Nurse scientists lead interdisciplinary teams investigating symptom biology and biomarkers to personalize treatment, e.g., cancer-related fatigue and neurological trauma	Nursing, bioinformatics, biomedical engineering, neuropsychology, medicine	Development of rapid diagnostic tests, identification of biomarkers guiding clinical intervention, improved symptom management	(25)
Nurse-Physician Collaboration in Intensive Care	Collaborative models emphasize shared decision-making, communication, and role clarity between nurses and physicians in ICU settings	Nursing, medicine	Improved clinical decision-making, enhanced patient safety, higher satisfaction among healthcare professionals	(26)
Public Health Nursing in Community Interventions	Nurses collaborate with epidemiologists, social workers, and public health officials to implement preventive care and address social determinants of health	Nursing, public health, social sciences	Increased health promotion, reduced health disparities, enhanced community health outcomes	(27)
Telehealth and Digital Health Integration	Nurses work with IT specialists, data scientists, and engineers to deploy telehealth services and AI-powered clinical tools	Nursing, computer science, engineering, informatics	Expanded access to care, improved patient monitoring, enhanced clinical workflow and patient safety	(28)
Interprofessional Education (IPE) Programs	Educational frameworks that train nursing and other health professions students together to foster collaborative practice	Nursing, medicine, pharmacy, allied health	Better teamwork skills, improved understanding of professional roles, preparation for collaborative clinical environments	(29)
Collaborative Practice in Global Health	Nurses lead and coordinate interdisciplinary teams addressing communicable diseases and chronic conditions in low-resource settings	Nursing, medicine, public health, social sciences	Improved disease control, more effective chronic disease management, capacity building in underserved regions	(30)

Together, these key areas show how interdisciplinary collaboration has not only broadened nursing science's scope but also enhanced its impact on healthcare delivery at multiple levels. The integration of diverse expertise, continuous innovation, and evidence-based policy development are instrumental in responding to evolving healthcare challenges and advancing nursing's contribution to global health.

6. Challenges and Barriers

Interdisciplinary collaboration in nursing science faces numerous challenges and barriers across structural, professional, communication, and ethical domains. Structural and institutional barriers often manifest as entrenched silos within academia and healthcare organizations, where disciplines operate largely independently. Funding structures traditionally favor single-discipline research, limiting resources and incentives for collaborative projects. Hierarchies in healthcare institutions perpetuate power imbalances, with physicians frequently positioned at the top, which can undermine nurses' contributions and create reluctance for open collaboration.⁽³¹⁾ Policies and payment systems that do not compensate collaborative time or practice also hinder sustained interdisciplinary teamwork, particularly in primary care settings.

Organizational shortcomings such as lack of leadership support, insufficient training in collaboration, and limited human resources exacerbate these structural constraints, making it difficult to establish environments where interdisciplinary collaboration thrives. Professional identity and role overlap present another significant challenge. Health professionals, including nurses, often have closely held professional cultures and identities that emphasize autonomy and specialized expertise. This can create territorial behavior, fears of loss of status or job function, and resistance to role blurring inherent in effective interdisciplinary collaboration. Unclear role boundaries and misunderstanding of other disciplines' scopes of practice further complicate cooperation, as team members may perceive contributions from other professionals as encroachments or undervaluation of their own skills. ⁽³²⁾These dynamics can lead to conflict, mistrust, and diminished willingness to engage in collaborative decision-making. Overcoming these complexities requires deliberate role clarification, respect-building, and cultivating a shared vision grounded in patient-centered goals.

Communication and cultural differences between disciplines add layers of challenge to collaboration. Professionals from nursing, medicine, pharmacy, social work, and allied health often use distinct terminologies, norms, and communication styles, which can create misunderstandings or information gaps. Time constraints and workload pressures reduce opportunities for effective information exchange and face-to-face interaction, weakening team cohesion.⁽³³⁾ Variations in training and expectations for communication, coupled with differing hierarchical perceptions, may inhibit open dialogue and feedback. Additionally, cultural differences, including variations in conflict resolution approaches and hierarchical sensitivities, require cultural competence and facilitation skills for teams to bridge gaps and foster trust. Mechanisms such as structured communication tools, regular interprofessional meetings, and shared electronic records are vital to overcoming these challenges.

Ethical and methodological complexities further complicate interdisciplinary collaborative research. Research teams must navigate diverse disciplinary standards, conflicting methodologies, and variations in ethical norms. Differences in emphasis on quantitative versus qualitative evidence, priorities in research questions, and approaches to data collection and analysis require negotiation and flexibility. Ethical concerns arise around patient confidentiality, informed consent, and the management of conflicts of interest in collaborative studies involving multiple professionals and institutions.⁽³⁴⁾ Maintaining equitable contributions and recognition among team members poses an additional challenge, particularly for nursing researchers who may face historic undervaluation in interdisciplinary grants and publications. Addressing these issues necessitates transparent governance structures, agreed-upon protocols, and ongoing dialogue to harmonize ethical and scientific standards, thus ensuring integrity and trust in collaborative research endeavors.

7. Future Directions in Nursing Science through Interdisciplinary Collaboration

The future directions of nursing science are increasingly shaped by the expanding opportunities and demands of interdisciplinary collaboration. Emerging fields such as genomics and data science are revolutionizing nursing research by enabling deep biological and computational insights into health and disease. Nurses equipped with genetics and bioinformatics knowledge collaborate with molecular biologists and computational scientists to explore genomic markers related to symptom biology and personalized treatments. This convergence promises more precise prevention, diagnosis, and management of complex diseases. Global health equity is a major impetus for collaborative initiatives, where nursing scientists partner with public health experts, social scientists, and policymakers to design interventions tailored to diverse populations.⁽³⁵⁾ They focus on mitigating health disparities, improving healthcare access, and building capacity in resource-limited settings, thus fostering equitable health outcomes worldwide. Nursing scientists are increasingly leading and contributing to multidisciplinary research consortia that bridge clinical, biological, behavioral, and computational sciences. At institutions like the National Institute of Nursing Research (NINR) within NIH, nurse scientists head teams that include bioinformaticians, engineers, neuropsychologists, dietitians, and physicians. These consortia focus on symptom science, integrating molecular, clinical, and behavioral data to develop interventions that improve quality of life for patients with chronic conditions such as cancer-related fatigue or

neurological trauma.(36) The leadership role of nursing scientists in these consortia exemplifies how nursing research training emphasizing clinical acumen, patient perspective, and interdisciplinary skills positions nurses to influence science strategically and collaboratively.

Artificial intelligence (AI), big data analytics, and digital health integration mark critical frontiers for nursing science. Nurses engage with data scientists and computer engineers to harness AI algorithms that predict patient risks, enhance clinical decision-making, and automate routine documentation. Big data enables identification of patterns across populations, informing personalized care pathways and resource allocation. The expansion of telehealth and mobile health technologies requires nurses to adopt new competencies and participate actively in the design and evaluation of digital tools that reliably extend care access, improve patient engagement, and elevate safety standards.(37) These technological advances emphasize an ongoing need for interdisciplinary educational and research frameworks that integrate nursing knowledge with data science, engineering, and ethical considerations.

The need for global collaborations to address pandemics and persistent health disparities has become increasingly urgent, as demonstrated by the COVID-19 pandemic. Nursing science contributes vital expertise in infection control, symptom management, health education, and community engagement on the global stage. Coordinated interdisciplinary networks spanning clinical, public health, and social science domains are critical to developing rapid, culturally appropriate, and equitable responses to emerging health threats. Nursing leadership in these networks includes fostering capacity building, supporting workforce development, and advocating for policies that prioritize equity and resilience in health systems worldwide.(38) As health challenges grow both in scale and complexity, interdisciplinary collaboration forms the foundation of nursing science's future role in protecting and promoting global health.

CONCLUSION

Interdisciplinary collaboration is a transformative force in nursing science, enhancing patient care, research, education, and healthcare systems. By uniting expertise from medicine, public health, social sciences, engineering, and data science, it fosters holistic, patient-centered care and drives innovation in treatment, prevention, and technology integration. Despite barriers such as role conflicts and communication challenges, collaborative models and interprofessional education strengthen teamwork, respect, and outcomes. Looking forward, advancements in genomics, big data, AI, and global health will require robust interdisciplinary leadership from nursing scientists. Ultimately, collaboration is indispensable for improving patient outcomes, advancing population health, and building resilient healthcare systems worldwide.

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