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## Conceptualizing Digital Nursing Competence for the Future of Digital Health

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### ABSTRACT

Digital transformation is reshaping nursing practice, education, and health-system governance worldwide, yet the concept of “digital nursing competence” remains fragmented across informatics-oriented, literacy-oriented, and critical-pedagogical traditions. Existing frameworks tend to privilege discrete technical skills over an integrated understanding of how nurses think, act, and adapt within continuously evolving sociotechnical environments. This paper undertakes a conceptual analysis to synthesize existing perspectives on digital competence in nursing and to propose an integrated conceptualization suited to the demands of future digital health ecosystems. Drawing on Rodgers' evolutionary concept-analysis approach, the paper reviews contemporary competency frameworks, empirical validation studies, and critical-theoretical commentaries published mainly between 2020 and 2026, identifying antecedents, attributes, and consequences of digital nursing competence. The analysis identifies five interdependent attributes referred to as foundational digital literacy, clinical informatics application, data and information governance, critical-ethical reasoning, and adaptive lifelong learning that together constitute a dynamic, developmental construct rather than a fixed skill set. A conceptual model, the Integrated Digital Nursing Competence (IDNC) model, is proposed to depict these attributes as nested and mutually reinforcing within individual, organizational, and policy layers. Digital nursing competence should be understood as an evolving professional capacity co-produced by individual learning, organizational readiness, and system-level governance. The IDNC model offers a coherent foundation for curriculum design, workforce policy, and future empirical research on nursing's role in digital health.

**Keywords:** Digital Nursing Competence; Digital Health; Nursing Informatics; Models, Future, Competency Framework; Digital Literacy; Concept Analysis

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## I. INTRODUCTION

The rapid diffusion of electronic health records, telehealth platforms, mobile health applications, wearable sensors, and artificial intelligence (AI)-enabled clinical decision support has fundamentally altered the conditions under which nursing care is delivered. As the largest occupational group in the global health workforce, comprising an estimated 27.9 million practitioners, nurses occupy a pivotal position in determining whether digital transformation translates into safer, more equitable, and more efficient care (World Health Organization [WHO], 2025).

Despite widespread policy recognition that digital capability is now core to professional practice, the conceptual foundations of “digital nursing competence” remain underdeveloped and inconsistently articulated across the literature. Adif et al. (2024) explicitly note that “inconsistencies in the conceptual understanding of digital competence in nursing literature” continue to hinder curriculum design and measurement, despite more than a decade of framework development beginning with the Technology Informatics Guiding Education Reform (TIGER) initiative. Some frameworks emphasize computer literacy and information-system proficiency (Staggers et al., as cited in workforce-competency literature); others foreground informatics knowledge embedded in clinical reasoning (Belchez et al., 2026); still others foreground the critical, ethical, and socio-political dimensions of technology use that purely technical models neglect (Wynn, 2025). The result is a conceptual landscape that is rich in instruments but thin in theoretical integration.

This paper addresses that gap through a conceptual analysis of digital nursing competence, with two aims. First, it synthesizes the antecedents, defining attributes, and consequences of the concept as it appears across recent informatics, education, and health-policy literature. Second, it proposes an integrated conceptual model the Integrated Digital Nursing Competence (IDNC) model intended to reconcile technical, cognitive, ethical, and adaptive dimensions of competence within a single developmental framework applicable across educational, clinical, and policy contexts. The paper is organized as follows: Section 2 situates digital nursing competence within the broader digital transformation of health systems; Section 3 critically synthesizes existing conceptualizations and frameworks; Section 4 identifies conceptual gaps; Section 5 presents the proposed IDNC model; Section 6 discusses implications for education, practice, and policy; and Section 7 concludes with directions for future research.

## 2. The Digital Transformation of Health Systems and the Nursing Workforce

The WHO Global Strategy on Digital Health 2020–2025 frames a digitally capable health workforce as a precondition for successful digital transformation, explicitly calling for digital health competencies to be embedded in education and training curricula for all health professionals (WHO, as cited in Frontiers scoping review on competency instruments, 2025). This ambition is reiterated regionally: the WHO European Region's Digital Health Action Plan 2023–2030 calls on member states to strengthen digital literacy and capacity-building for the health workforce, and assessments in several countries continue to reveal substantial gaps between policy ambition and workforce readiness.

One national assessment found that just over half of surveyed healthcare professionals demonstrated only basic or beginner-level digital literacy (Formalizing digital health competencies for the health workforce in Ukraine, 2026). Nursing's centrality to this agenda is underscored by the State of the World's Nursing 2025 report, which emphasizes that nurses “must be prepared and fully supported to competently utilize digital technologies across areas of professional practice from education to practice, research and management” (as cited in SNOMED International, 2025). Complementing this workforce-level framing, Van Kessel et al. (2025), in a WHO-affiliated scoping review and expert consensus, identify digital access, infrastructure, governance, organizational readiness, and workforce capability as interlinked “digital determinants of health,” situating individual clinician competence within a broader system of enabling or constraining conditions. This systems view is important: it implies that digital nursing competence cannot be adequately theorized purely as an individual-level skill set, but must be understood as emergent from the interaction between individual capability, organizational infrastructure, and policy environment.

At the same time, nursing and midwifery leadership in shaping digital health policy remains underdeveloped. Protocol-stage research examining the WHO European Region's digital health governance found major evidence gaps regarding nursing and midwifery leadership across the domains of leadership, jobs, education, and service delivery outlined in the Global Strategic Directions for Nursing and Midwifery (digital nursing and midwifery leadership protocol literature, 2025). Nurses are consequently positioned simultaneously as the profession most affected by digital transformation and as a profession whose voice in shaping that transformation has been comparatively marginal—a tension that motivates a more precise conceptualization of what digital competence should mean for the profession, rather than competence borrowed uncritically from adjacent technical fields.

### **3. EXISTING CONCEPTUALIZATIONS OF DIGITAL COMPETENCE IN NURSING: A CRITICAL SYNTHESIS**

#### **3.1 Informatics-Centered Frameworks**

The earliest and most influential framework, the TIGER initiative, emerged in 2009 to articulate information-technology competencies required for professional nursing practice and substantially shaped the subsequent emphasis on informatics within U.S. nursing education standards (as discussed in Digital and informatics competencies literature on nursing leaders in Canada). More recently, the Multimodal Nursing Informatics Framework (MNIF), developed by the Nursing Knowledge Big Data Science Initiative Education Workgroup, integrates five conceptual models to link theory, reflection, and practice, explicitly targeting nurse educators who “lack the confidence and tools to teach informatics effectively within their curricula” (Belchez et al., 2026). These informatics-centered approaches share an important strength: they connect digital skill to demonstrable clinical outputs such as documentation accuracy, clinical decision support use, and interoperable data exchange.

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Their limitation is a tendency to conflate digital competence with informatics competence, a distinction Adif et al. (2024) explicitly draw, noting that digital competence constitutes the “basic skills or daily abilities required to engage with the digital world,” whereas informatics is a specialized sub-field concerned with developing and applying health technologies. Collapsing the two risks producing curricula that are technically sophisticated but inaccessible to the broader population of general and community nurses who do not require advanced informatics specialization.

### 3.2 Literacy- and Competence-Assessment Frameworks

A second stream of literature operationalizes digital competence as a multidimensional, measurable construct. Adif et al. (2024), through a two-phase Delphi and psychometric validation study spanning Taiwan, Indonesia, and Vietnam, developed the Digital Competence Assessment Checklist (DCAC), defining digital competence across four domains: proficiency in using digital media and resources, digital communication proficiency, cognitive capacities for digital learning, and digital safety. This framework was subsequently operationalized in the DigiNurse e-learning program, a modified-Delphi-validated curriculum aligning instructional modules with each DCAC domain across the same three countries. Complementary cross-national work using the Self-Assessment of Nursing Informatics Competencies Scale (SANICS) among Chinese undergraduate nursing students similarly conceptualizes competence as encompassing knowledge, perceptions, and self-perceived skill, while cautioning that self-report measures capture perceived rather than objectively demonstrated performance. These frameworks provide much-needed measurement rigor and cross-cultural validation. Yet, being assessment-driven, they tend to describe competence as a checklist of static abilities rather than as a capacity that develops dynamically in response to changing technologies.

### 3.3 Ecological and System-Level Frameworks

A third stream situates digital competence within broader socio-organizational ecosystems. Conte et al. (2023), in a scoping review spanning primary to tertiary care settings, proposed the Digital and Technological Framework (Digitech-F), arguing that effective adoption of digital and technological solutions in nursing depends jointly on knowledge, competence, attitude, and self-efficacy, and identifying ethical concerns about data ownership as a persistent barrier to implementation. This ecological framing resonates with the European Union's DigComp framework, which conceptualizes digital competencies generally as an integration of knowledge, skills, and attitudes supporting confident, critical, and responsible technology use—language increasingly adopted in national digital-health-workforce policies. The strength of these frameworks lies in acknowledging that competence is co-produced with organizational context; their limitation is that they are often pitched at a level of abstraction that is difficult to translate directly into nursing curricula or clinical performance standards.

### 3.4 Critical-Pedagogical Perspectives

A fourth and more recent stream challenges the adequacy of competency-based framing altogether. Wynn (2025), drawing on Freirean critical pedagogy, argues that nursing remains in the “foothills of digital transformation,” with existing frameworks providing insufficient theoretical grounding for students to interrogate the socio-political and ethical implications of the

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technologies they are trained to use. This perspective proposes a shift from purely competency-based education toward reflective, dialogical engagement with technology grounded in praxis—problem-posing education that treats nurses as active interpreters of digital tools rather than passive adopters of predefined skill sets. Although this critical stream has not yet been operationalized into assessable competencies, it identifies an attribute largely absent from technical and psychometric frameworks: the capacity for critical, ethically reflective judgment about digital technology itself, including its limitations, biases, and implications for the nurse–patient relationship.

### **3.1 Conceptual Gaps in Current Models**

Read together, four gaps emerge from this literature. First, there is definitional inconsistency: digital competence, digital literacy, and informatics competence are used inconsistently and sometimes interchangeably, a problem Adif et al. (2024) identify as a direct barrier to coherent curriculum design and instrument development. Second, most frameworks are static rather than developmental; they specify what a competent nurse can currently do but rarely theorize how competence should evolve as technologies such as generative AI, ambient clinical documentation, and predictive analytics mature. Third, ethical and critical reasoning capacities are underrepresented in assessment-oriented frameworks even though critical-pedagogical scholarship identifies them as essential (Wynn, 2025), and even though data-ownership and governance concerns are repeatedly flagged as implementation barriers (Conte et al., 2023). Fourth, existing frameworks are largely individual-level, whereas system-level scholarship demonstrates that competence is enabled or constrained by infrastructure, governance, and organizational readiness (Van Kessel et al. 2025) factors that individual-level competency checklists cannot capture but that materially determine whether competence translates into practice.

These gaps suggest that what nursing needs is not another discrete skills inventory, but an integrative conceptual architecture capable of holding technical proficiency, ethical judgment, and system-level enablement together as interacting, mutually necessary components of a single construct.

### **3.2. Toward an Integrated Conceptualization: The IDNC Model**

Building on Rodgers' evolutionary view of concepts as context-dependent and continuously evolving, this paper proposes that digital nursing competence be conceptualized as a dynamic professional capacity comprising five interdependent attributes, nested within three levels of enablement.

#### **3.2.1 Five Core Attributes**

Foundational digital literacy refers to the basic operational and informational skills needed to navigate digital devices, platforms, and health information sources, consistent with the media- and resource-use domain identified by Adif et al. (2024). Clinical informatics application denotes the capacity to integrate electronic health records, decision-support tools, and interoperable data systems into clinical reasoning and workflow, extending the informatics-centered emphasis of the MNIF (Belchez et al., 2026).

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Data and information governance encompass competence in data security, privacy protection, and stewardship of patient information across digital systems, reflecting the digital-safety domain of the DCAC and the data-ownership concerns raised in the Digitech-F review (Conte et al., 2023). Critical-ethical reasoning captures the capacity to interrogate the socio-political, ethical, and equity implications of digital tools including algorithmic bias and the erosion of relational care—drawing directly on Freirean critical pedagogy (Wynn, 2025). Adaptive lifelong learning denotes the disposition and self-regulatory capacity to continuously update competence as technologies evolve, addressing the developmental gap identified in Section 3.1.

### **3.2.2 Three Levels of Enablement**

These five attributes are theorized as necessary but not individually sufficient; their translation into practice depends on three nested levels of enablement. At the individual level, competence depends on prior digital literacy, professional identity, and motivation to learn. At the organizational level, competence depends on the availability of interoperable systems, protected learning time, mentorship and a culture that tolerates the experimentation inherent in technology adoption. At the systems/policy level, competence depends on national digital health strategies, regulatory clarity regarding data governance, and the degree to which nursing has a genuine voice in digital health policy formation addressing the leadership gap noted in nursing and midwifery digital-policy scholarship. The IDNC model thus depicts digital nursing competence not as a property residing solely within the individual nurse, but as a capacity co-produced across these three nested levels, consistent with the digital-determinants-of-health framing advanced by Van Kessel et al. (2025). A practical implication of this nested structure is that interventions aimed solely at individual skill-building (e.g., short digital-literacy workshops) are unlikely to produce durable competence gains unless accompanied by organizational investment in infrastructure and mentorship, and by policy environments that grant nurses agency in shaping the digital tools they are expected to use.

## **4. DISCUSSION: IMPLICATIONS FOR EDUCATION, PRACTICE, RESEARCH, AND POLICY**

### **4.1 Implications for Nursing Education**

Curricula should move beyond stand-alone informatics modules toward longitudinal, spiraled integration of all five IDNC attributes across pre-registration and continuing-education programs. The DigiNurse program's alignment of instructional modules with validated competence domains offers a workable template, but curricula should additionally incorporate the critical-reflective pedagogy advocated by Wynn (2025) so that students learn not only to use digital tools competently but to question their design, limitations, and ethical implications.

### **4.2 Implications for Clinical Practice and Organizations**

Healthcare organizations should treat digital competence as an organizational property to be cultivated through protected learning time, super-user mentorship models, and continuous feedback between frontline nurses and system designers—rather than as an individual deficit to be remediated through one-off training. Embedding structured evaluation of data-governance and cybersecurity competence within routine clinical-competency review cycles would operationalize the governance attribute identified in the IDNC model.

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#### 4.3 Implications for Policy and Workforce Planning

At the policy level, national digital-health strategies should explicitly name nursing-specific competence requirements rather than subsuming them within generic health-workforce digital-literacy targets, and should create structured mechanisms for nursing and midwifery representation in digital-health governance bodies, addressing the leadership gap documented in recent WHO European Region protocol research. Workforce planners should also monitor the digital determinants of health identified by Van Kessel et al. (2025), infrastructure, governance, and organizational readiness as leading indicators of whether investments in nurse-level competence are likely to translate into improved patient outcomes.

#### 4.4 Implications for Research

Future empirical work should test the IDNC model's proposed structure, examining whether the five attributes are empirically separable and whether organizational and policy enables moderate relationship between individual competence and clinical outcomes. Longitudinal designs would be particularly valuable for capturing the developmental, rather than static nature of competence as new technologies such as generative AI and ambient documentation tools diffuse into practice.

### 5. LIMITATIONS

As a conceptual analysis rather than a systematic review, this paper's synthesis is necessarily selective and privileges recent, prominent framework over an exhaustive census of the literature. The IDNC model is theoretically derived and has not yet been empirically validated; its five attributes and three enablement levels should be treated as testable propositions rather than established findings. Finally, most of the frameworks reviewed originate from high- and upper-middle-income country contexts (notably Taiwan, Indonesia, Vietnam, the United States, and the WHO European Region), the model's applicability in low-resource and low-connectivity settings warrants dedicated empirical attention.

### 6. CONCLUSION

Digital nursing competence is currently theorized through fragmented, largely non-communicating traditions, informatics-centered, psychometric, ecological, and critical-pedagogical that each capture part, but not the whole, of what nurses need to practice safely and meaningfully within digitally mediated health systems. This paper has argued that digital nursing competence is better understood as a dynamic, developmental capacity comprising foundational digital literacy, clinical informatics application, data and information governance, critical-ethical reasoning, and adaptive lifelong learning, and that this capacity is co-produced across individual, organizational, and policy levels rather than residing solely within the individual practitioner. The proposed Integrated Digital Nursing Competence (IDNC) model offers a coherent conceptual foundation for redesigning nursing curricula, structuring organizational investment in digital readiness, and informing workforce policy as health systems continue their digital transformation.

As nursing world's largest workforce, is called upon to lead and not merely adapt to this transformation, a clearer, more integrative conceptualization of digital competence is a necessary foundation for that leadership to be realized.

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