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Defining Nursing Care Devices in Nursing Practice: A Conceptual Framework for Nursing Management

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ABSTRACT

Aim: To conceptualize nursing care devices from a nursing disciplinary perspective, using the hybrid model of concept analysis, to inform nursing management, practice, and policy.

Background: Despite the rapid proliferation of clinical technologies, devices used in nursing practice are often conceptually categorized only as "medical devices," marginalizing nursing expertise. This conceptual gap contributes to the exclusion of nurses from decision-making and workflow mismatches, underscoring the need for a nursing-specific conceptualization that integrates clinical judgment with organizational systems.

Methods: A hybrid model of concept analysis was applied across three phases. The theoretical phase comprised a systematic literature review of 29 empirical and conceptual articles (2015–2025). The fieldwork phase comprised in-depth, semistructured interviews with five experienced nurses at a tertiary hospital. The final analytical phase integrated both data sources to derive a comprehensive definition and framework.

Results: In this study, nursing care devices are conceptualized as technological tools that nurses autonomously select and use—based on professional judgment—within nursing practice to support patient treatment, recovery, safety, and participation in care. Four core dimensions emerged—technological efficacy, organizational integration, patient engagement, and professional autonomy—which reframe devices as practice resources embedded within nursing care and organizational systems.

Conclusions: These devices can be understood as multidimensional mediators linking technology, practice, and caring relationships. Their organizational value may depend on the extent to which professional judgment is supported by robust technology governance and leadership.

Implications for Nursing Management: The framework offers a conceptual framework for examining technology governance at the organizational, workforce, and policy levels. Nurse managers should lead device selection and implementation processes to promote alignment with clinical workflows and to consider how potential time savings from automation could be redirected toward direct patient care and safety monitoring.

1 | Introduction

Nursing practice has been rapidly transformed by the increasing use of diverse technological devices in clinical settings, including patient monitoring systems, wearable sensors, and telehealth platforms [1–3]. Nurses are now central users and coordinators of these technologies, integrating device-generated data into ongoing patient assessment, clinical decision-making, and care delivery [4–6]. These technologies show potential to improve clinical outcomes and support patient self-management, particularly in chronic disease care and remote health management contexts [7–9].

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However, despite their central role in device use, nurses are frequently excluded from decision-making processes related to device selection, implementation, and evaluation [10]. In many healthcare organizations, such decisions are led by administrative or physician-centered structures, resulting in a misalignment between technological systems and the realities of frontline nursing practice. This disconnect contributes to workflow mismatches that occur when devices are introduced without sufficient consideration of nursing workload, care processes, or clinical priorities [11–14].

Consequently, technologies intended to enhance efficiency may instead create unintended burdens. A prominent example is alarm fatigue, a well-documented patient safety issue arising from excessive or poorly configured device alerts that can overwhelm nurses, reduce responsiveness to critical signals, and compromise the quality of care [12, 13]. These issues indicate that the challenges associated with device use are not merely technical but also fundamentally organizational and managerial in nature [15–17].

Despite these challenges, devices used in nursing practice continue to be conceptualized within the broader category of "medical devices," and nursing perspectives have historically been underrepresented in medical-device development [18]. Such conceptualizations emphasize technical performance and regulatory classification but may not capture how devices are embedded within nursing workflows, interpreted through clinical judgment, and managed in complex care environments. Consequently, the role of nurses as active mediators of technology—through continuous monitoring, contextual interpretation, patient education, and care coordination—remains insufficiently conceptualized within nursing science [10, 14].

From a nursing management perspective, this conceptual gap has critical implications. Without a clear understanding of how devices function within nursing practice, healthcare organizations may face difficulties in developing effective governance structures, aligning technology with workflow design, and supporting nurses in the safe and efficient use of devices [11, 19]. Furthermore, the absence of a nursing-specific conceptualization limits nurse managers' ability to advocate for appropriate roles, responsibilities, and decision-making authority in technology-related processes.

To address this gap, devices used in nursing practice need to be conceptualized from a nursing-specific perspective, with attention to their integration with nurses' clinical judgment, patient-centered care, and organizational systems [20]. This conceptualization provides a foundation for aligning device implementation with workflow redesign, workforce development, and patient-safety strategies in digitally evolving healthcare environments [21].

Medical devices constitute a regulatory product category defined by their intended medical purposes [22, 23]. In contrast, nursing care devices, as conceptualized in this study, represent a nursing-specific practice concept that describes how devices are integrated into the nursing process through nurses' professional judgment. Thus, the devices examined in this study may also be classified as medical devices, although their integration into the nursing process through professional judgment can be understood from a nursing practice perspective.

Accordingly, this study adopted the hybrid model of concept analysis developed by Schwartz-Barcott and Kim, which combines theoretical analysis with empirical fieldwork to examine how a concept operates in real-world clinical contexts [20, 24, 25]. The aim of this study was to define nursing care devices conceptually and to develop a conceptual framework to inform nursing management, practice, and policy.

2 | Materials and Methods

2.1 | Data Sources

This study applied the hybrid model of concept analysis developed by Schwartz-Barcott and Kim to analyze the concept of nursing care devices [24]. The model comprises three iterative phases—a theoretical phase based on a literature review, a fieldwork phase involving empirical data collection in clinical settings, and a final analytical phase that integrates both data sources—to clarify and refine the essential nature of the concept.

2.2 | Theoretical Phase

In the theoretical phase, a systematic literature review was conducted to derive a provisional definition and preliminary attributes of nursing care devices.

2.3 | Data Sources and Search Strategy

We searched for literature published between January 2015 and August 2025. The final searches were conducted in PubMed on August 30, 2025; CINAHL on August 20, 2025; ProQuest Central on August 21, 2025; RISS on August 23, 2025; and DBpia on August 23, 2025. Database-specific search strategies combined controlled vocabulary, such as Medical Subject Headings terms, with free-text keywords identified through text mining, adapted to each database. The same English search string was "nursing device" OR "nursing equipment" OR "medical device" OR "nursing instrument" OR "nursing kit."

2.4 | Study Selection

The inclusion criteria were as follows: (1) empirical or conceptual studies in which the primary users of the devices or equipment were nurses; (2) studies that described the attributes, antecedents, and/or consequences of device use in nursing practice; and (3) full-text articles available in Korean or English.

The exclusion criteria were as follows: (1) devices used exclusively for physician-led diagnosis or surgery; (2) studies focused primarily on pharmacological therapy or disposable supplies; (3) non-clinical information technology systems and consumer wellness products; and (4) studies on educational simulators or questionnaire development.

The study selection process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines [26] (Figure 1). Of the 6940 records initially identified, 6184 remained after duplicate removal. Titles and abstracts were screened by one researcher against the predefined eligibility criteria. Full-text articles were then independently assessed by two researchers, and any disagreements regarding eligibility were resolved through discussion and consensus. Following the final eligibility assessment, 29 studies were included (Table 1).

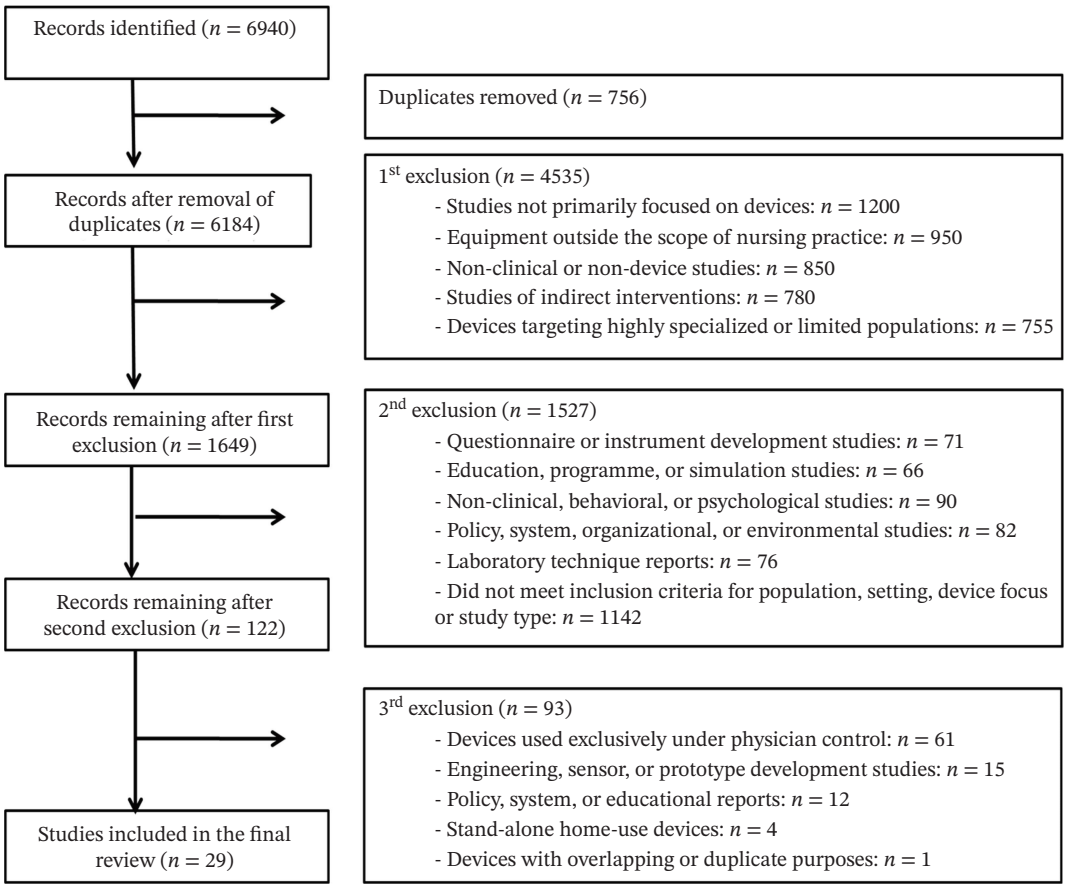

FIGURE 1 | Nursing device concept analysis: PRISMA diagram.

2.5 | Data Extraction and Synthesis

Two researchers independently extracted data on authors, year of publication, type of device, definitions, and attributes.

2.6 | Fieldwork Phase

The fieldwork phase examined how the provisional attributes identified in the theoretical phase were manifested and reconstructed in clinical practice.

2.7 | Participants and Setting

The participants were five experienced nurses working in medical and surgical wards and in the intensive care unit of a tertiary hospital. All five participants had a minimum of 3 years of clinical experience (mean clinical experience = 17.4 years). Participants were purposively selected based on their relevant experience with nursing care devices. The sample size was consistent with the recommended range for the fieldwork phase of the hybrid model. Recurring concepts and attributes were observed across the interviews; however, data saturation was not formally assessed using predefined criteria or a structured saturation-tracking procedure (Table 2).

2.8 | Data Collection and Analysis

Data were collected through individual, semistructured, in-depth interviews conducted from August 11 to 14, 2025. The guiding questions included, "How would you define nursing care devices in your clinical practice?", "What experiences have you had as a nurse when using these devices?", and "How do these devices influence your work and your patients?" All interviews were audio-recorded and transcribed verbatim.

Data were analyzed using the inductive content analysis approach described by Elo and Kyngäs [27]. Meaning units were identified, coded, and grouped into subcategories and categories, which were then abstracted into overarching themes.

2.9 | Final Analytical Phase

In the final analytical phase, data from the theoretical and fieldwork phases were integrated to refine the attributes of nursing care devices and to derive a comprehensive definition. Constant comparative analysis was performed to compare attributes from the literature with themes that emerged from the interviews, enabling cross-validation and refinement [28].

Rigor was enhanced through researcher triangulation: Several members of the research team independently reviewed the data and then discussed them to identify patterns of convergence, expansion, and refinement between the theoretical and empirical findings. Through this iterative process, the final attributes, antecedents, and consequences of the concept were systematically organized.

2.10 | Ethical Considerations

Ethical approval was obtained from the Institutional Review Board of the authors' affiliated institution (No. 40525 202301 HR

TABLE 1 | Characteristics of the studies included in the theoretical phase.

No.	Author	Method	Publication year	Country	Nursing care device
1	Xu et al.	Systematic review	2024	Australia	Dressings devices
2	Gu et al.	RCT	2023	China	Compression device (alarm)
3	Schreiber et al.	RCT	2016	Italy	Cooling vibration device
4	Choi et al.	Comparative ob. study	2022	South Korea	Smart wearable thermometer
5	Batalik et al.	RCT	2020	Czech Republic	Wearable heart rate monitor
6	Anwar et al.	Comparative trial	2020	Egypt	Enteral feeding system
7	Volsko	Narrative review	2019	USA	CPAP Device
8	Lu et al.	Quasi-experimental	2019	Taiwan	Remote healthcare device
9	Song et al.	RCT	2020	China	Smartphone rehab program
10	Treskes et al.	RCT	2020	Netherlands	Smartphone health monitoring
11	Tran et al.	RCT	2019	USA	Tourniquet
12	Bieser et al.	Clinical trial	2018	Germany	New dialysis system
13	Luo et al.	System review	2021	China	Wearable glucose management device
14	Benigni et al.	Pilot RCT	2018	France	Edema reduction device
15	Ray et al.	Scoping review	2024	Australia	Portable ultrasound device
16	Leahy et al.	Review	2015	USA	Home cardiovascular monitor
17	Avila et al.	RCT	2020	Belgium	Remote exercise program
18	Kim et al.	Opinion paper	2018	South Korea	ICT-based depression tool
19	Bergenstal et al.	RCT	2019	USA	Insulin patch and pen
20	Yoo et al.	Review	2024	South Korea	Mobile health app
21	Barata et al.	Prospective trial	2023	Switzerland	Smartphone cough monitor
22	Karpiel et al.	Review	2025	Poland	Respiratory sensor
23	Gibney et al.	RCT	2016	USA	Catheter infusion set
24	Nakayama et al.	Review	2023	Japan	Wearable cardiac rehab device
25	Hasuo et al.	Pilot RCT	2019	Japan	Resonant breathing device
26	Wu et al.	Review	2024	China	Wound measurement device
27	McNeely et al.	RCT	2018	USA	VeinViewer® device
28	Jo et al.	Qualitative study	2024	South Korea	Mobile barcode medication system
29	Kim et al.	Qualitative study	2021	South Korea	Patient monitoring device alarm

090 04). All participants received verbal and written information about the study's purpose, procedures, voluntary participation, and confidentiality. Written informed consent was obtained from all nurse participants prior to data collection. Participants were informed that they could withdraw at any time without penalty. The audio recordings were securely stored and destroyed after analysis, and all personal identifiers were removed and replaced with codes to ensure anonymity.

3 | Results

3.1 | Overview of the Concept

3.1.1 | Theoretical Phase

In the theoretical phase, the literature was analyzed to identify the definitions, antecedents, attributes, and consequences that comprise the concept of nursing care devices. This analysis showed that nursing care devices extend beyond technical artifacts and are associated with multidimensional influences on nursing practice, organizations, and patient outcomes. Detailed results are summarized in Table 3.

3.1.2 | Definition in the Literature

Across the reviewed studies, nursing care devices were defined not as passive instruments secondary to physicians' orders but as technological tools that nurses autonomously select and use based on clinical expertise and judgment to support diagnosis, treatment, recovery, rehabilitation, and patient safety [14]. These devices span a broad technological spectrum, from basic monitoring equipment to advanced smart systems integrating artificial intelligence (AI) and Internet of Things technologies [3, 14].

Furthermore, the literature positions nurses' roles in device selection, installation, data interpretation, evaluation, and management as a distinctive domain of professional nursing practice [14, 29–31]. In this sense, these devices function as mediating mechanisms through which nurses' clinical competence and patient-centered care are enacted through technology [13, 14, 31].

TABLE 2 | Demographic characteristics of fieldwork participants ($n = 5$).

Participant	Age	Position	Educational level	Clinical experience	Dealing with nursing care device
1	46	RN	BSN	21	a, b, c, d, e
2	46	RN	MSN	21	a, f, g, h, I, j, k, l, m, n, o
3	46	RN	MSN	21	a, f, g, h, I, j, k, l, m, n, o
4	46	RN	MSN	21	a, f, g, h, I, j, k, l, m, n, o
5	29	RN	BSN	3	a, f, g, h, I, j, k, l, m, n, o

Note: Nursing care devices: a logistics and delivery robot; b capsule (Philips Medical Device Information Platform); c body warmer; d disposable blanket; e automated dispensing cabinet; f smart ring; g blood pressure monitor; h thermometer; I all prevention mat; j patient lift; k smart bed system; l automatic vital signs measurement system; m patient monitor and alarm system; n guidance robot; o unit dose system.
Abbreviations: BSN, Bachelor of Science in Nursing; MSN, Master of Science in Nursing; RN, registered nurse.

3.1.3 | Antecedents

The antecedents that drove the introduction and expansion of nursing care devices reflect the interaction of technological, clinical, professional, and sociocultural factors.

First, rapid technological advancements and the shift toward evidence-based nursing have accelerated device adoption. The convergence of AI, sensor technologies, and wearable systems has enabled real-time monitoring and data-driven decision-making, particularly in response to the increasing demand for remote and contactless care [3, 32–36].

Second, patient safety initiatives and the expansion of nursing roles have further promoted the utilization of devices. The increasing emphasis on error reduction, protocol adherence, and continuous monitoring has strengthened nurses' roles in data collection and clinical judgment across various care processes [4–6, 13, 14, 37].

Third, the expansion of patient-centered care has changed how devices are conceptualized and used. As patients transition from passive recipients to active participants, technological tools have become essential for enhancing self-management and individualized care delivery [32, 33, 37].

Finally, demographic changes and the complexity of the healthcare system act as macrolevel antecedents. Population aging, the rise of chronic diseases, and healthcare resource constraints have driven the development of remote care systems and equitable access strategies, further reinforcing the need for nursing care devices [32–36].

3.1.4 | Attributes

The literature indicates that nursing care devices possess multidimensional attributes spanning technological, organizational, and practice-oriented domains.

From a technological perspective, these devices enable real-time data collection and analysis, provide alerts and decision support, and deliver objective information to inform clinical judgment, which may strengthen the evidence base for nursing interventions [32–36].

Safety and reliability are also key attributes, including accurate measurements, high sensitivity, and automated safety mechanisms that support continuous monitoring in high-risk clinical environments [32, 38–40].

Device performance, monitoring capability, humidification, and safety features were also identified as important considerations in selecting and using clinical devices across different care settings [41].

From an organizational perspective, system integration and remote monitoring enable data sharing across time and space, facilitate interprofessional collaboration and task redistribution, and support efficient resource allocation, which may contribute to a stronger patient safety culture [33, 36].

From a practical perspective, usability features such as intuitive interfaces, portability, and noninvasive designs enhance feasibility for both patients and nurses. Reduced device complexity and simplified handling may further support usability in clinical practice [42]. Additionally, customizable settings and real-time feedback mechanisms support patient engagement, understanding, and self-management [35, 37].

3.1.5 | Consequences

The use of nursing care devices has multidimensional consequences across clinical, practical, organizational, and societal levels.

At the clinical level, some of the reviewed studies reported improvements in selected physiological outcomes, such as blood pressure and glycemic control, as well as reductions in complications associated with specific device-supported interventions [4, 7, 8, 32, 39, 43]. Comparative device studies also assessed procedure-related outcomes, such as first-attempt success in peripheral intravenous cannulation, although the compared tourniquet techniques did not necessarily differ in effectiveness [44].

At the practice level, automated monitoring and documentation have been reported to reduce nurses' manual workload and enable greater focus on direct patient care, while also expanding nurses' roles from device operators to clinical data interpreters and care coordinators [4–6, 13, 14, 36].

At the organizational and societal levels, remote patient monitoring has also been associated with reductions in hospital admissions and lengths of stay in some clinical populations [45].

3.2 | Fieldwork Phase: Empirical Validation

In-depth interviews were conducted with five nurses working at a tertiary hospital to explore how they defined nursing care

TABLE 3 | Antecedents, attributes, and consequences of nursing care devices in the theoretical phase.

Components	Categories	Key elements
Antecedents	Demand for technological innovation	- Integration of IoT, AI, sensor and wearable technologies into clinical practice - Expansion of real-time monitoring and telehealth infrastructure
	Patient safety and quality improvement	- Need for evidence-based practice and standardized clinical protocols - Need to reduce medical errors and implement tailored safety management
	Need to strengthen nursing capacity	- Enhancement of clinical judgment and technical proficiency - Development of efficient nursing services and multidisciplinary collaboration systems
	Patient-centered paradigm	- Strengthening patient engagement and self-management capacity - Improving personalized treatment and access to care
	Increasing complexity of the healthcare environment	- Population aging, chronic disease - Workforce shortages and rising healthcare costs - Pandemic response and expansion of community-based continuous care
Attributes	Technological integration	- Integrated platforms for real-time data collection and analysis - AI-based predictive analytics and interoperability between systems
	Safety and reliability	- Accurate measurements with high sensitivity and specificity - Automated safety mechanisms and consistent monitoring
	User-centeredness	- Intuitive interfaces and non-invasive measurements—portability and flexible applicability
	Connectivity and continuity	- Remote monitoring and real-time feedback - Effective communication among patients, nurses, and the healthcare team
	Personalization and adaptability	- Customized settings based on individual patient characteristics - Adaptability to diverse clinical environments and promotion of patient engagement
Consequences	Clinical outcomes	- Improvement in health indicators such as HbA1c and blood pressure - Reduced complications and readmission rates; improved procedure success rates
	Innovation in nursing practice	- Strengthened clinical judgment and professional competence - Consolidation of evidence-based practice and increased work efficiency
	Redefinition of roles and professional identity	- Expansion from technical operator to clinical interpreter - Roles as patient educator, health coach, and tele-nursing specialist
	Organizational system improvement	- Enhanced culture of patient safety and improved quality indicators - More efficient use of healthcare resources and development of innovative service models
	Advancement of the healthcare system	- Establishment of telehealth ecosystems and continuous care systems - Improved health equity and strengthened public health response capacity

devices, the meanings they attached to them, and their experiences using them in practice. The analysis yielded five major themes.

3.2.1 | Theme 1: Practice Tools Grounded in Autonomous Judgment

The participants clearly distinguished nursing care devices from medical equipment used solely under a direct physician's prescription. In practice, they defined nursing care devices as tools that nurses themselves judge necessary for monitoring and responding to patients' changing conditions; select, apply, and adjust independently; and use to interpret the resulting data as part of nursing care. Within the fieldwork context, participants described who exercised primary control over device use as an important practical criterion.

> "They're different from things like computed tomography or magnetic resonance imaging that physicians order. Thermometers, glucometers, even setting the monitor alarms... these are things I decide to use when I judge that the patient needs them. For me, nursing care devices are tools that I use as the primary decision-maker." (Participant 1: 21 years of experience)

> "The machine itself belongs to the hospital, but how it is applied to the patient and how the data are interpreted is entirely up to my judgment. It is a professional tool that completes my nursing practice." (Participant 4: 21 years of experience).

3.2.2 | Theme 2: An Extended Medium of Care

Nurses perceived nursing care devices as an "extended medium of care" that continues to protect and monitor patients even when nurses cannot be physically present. Devices are regarded as indispensable partners that compensate for nurses' physical limitations and enable continuous care.

> "In the intensive care unit, even when I am with another patient, the monitor is still watching over them. It feels like a 'second set of eyes' that sees what I cannot. Without these devices, providing uninterrupted care 24 h a day would be impossible." (Participant 3: 21 years of experience)

3.2.3 | Theme 3: A Safe Partner That Facilitates Patient Participation

Nurses described nursing care devices as potentially facilitating patient participation. They reported that, when objective device-generated data were shared with patients, the patients appeared more aware of their conditions and more willing to participate in treatment. These observations reflect nurses' reported experiences and were not based on direct assessments of patients' perceptions or engagement. Nurses also described a sense of safety and comfort as important for supporting meaningful patient participation.

> "When I go over the wearable data with patients, their attitude really changes. They see for themselves, 'Oh, the numbers improve every time I walk,' and then they start going out to exercise on their own without being told. The device turns them into partners in the treatment process." (Participant 5: 3 years of experience)

3.2.4 | Theme 4: The Paradox of Efficiency and Burden

Although nurses acknowledged the technological efficiency of the devices, they simultaneously experienced "paradoxical inefficiency" arising from an increased workload during the early stages of implementation and technical instability. Automated documentation was reported to save time. However, frequent alarm management and routine device maintenance had become additional sources of stress.

> "Linking to the electronic medical record definitely reduced the time I spend recording vital signs. It's nice because I can use that time to actually look patients in the eye. But I'm also constantly changing batteries, fixing errors... Sometimes I'm not sure if I'm a nurse or a technician." (Participant 4: 21 years of experience).

3.2.5 | Theme 5: The Boundary Between Professional Autonomy and Liability

Nurses exercised a high degree of clinical autonomy when using devices; however, the ambiguity surrounding legal responsibility for device-related incidents or malfunctions constrained this autonomy. Concerns regarding liability often accompanied autonomous decisions to modify or discontinue the use of a device.

> "When a patient is really struggling, there are times I temporarily remove the monitor even without a physician's order. That's my clinical judgment. But I always make that decision with anxiety, wondering, 'If something happens now, will I be held fully responsible?'" (Participant 2: 21 years of experience).

4 | Results of the Final Analytical Phase

The integration of the theoretical literature review and fieldwork findings refined the concept of nursing care devices into four interrelated core dimensions: technological efficacy, organizational integration, patient engagement, and professional autonomy (Figure 2).

4.1 | Technological Efficacy

The theoretical attribute of digital automation was combined with the field-derived attribute of practical efficiency to form the first dimension. Participants confirmed that automated data collection shortened their task time; however, they also revealed that technical limitations, such as battery depletion and frequent alarms, generated a "paradoxical burden" that could undermine perceived efficiency. Accordingly, this dimension was redefined

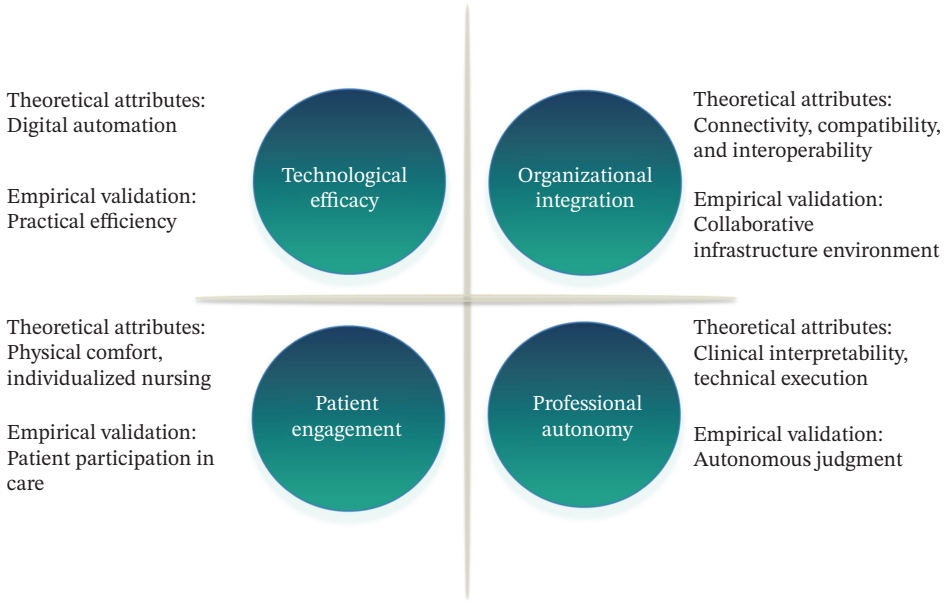

FIGURE 2 | Conceptual framework of nursing care devices.

to go beyond functional superiority, emphasizing that technological advantage may translate into perceived efficiency in practice only when technical stability is ensured.

4.2 | Organizational Integration

The theoretical attributes of connectivity, compatibility, and interoperability were expanded and redefined during the fieldwork phase as part of a collaborative infrastructure environment. While the literature mainly highlights technical linkages between systems, the empirical analysis demonstrates that organizational integration also involves physical infrastructure, interprofessional communication, and reimbursement policies. Physician-centered educational structures and the lack of reimbursement for device-related nursing activities emerged as major barriers to effective use; this underscores that organizational readiness may be a precondition for successful technology implementation.

4.3 | Patient Engagement

This dimension emerged from integrating the theoretical attributes of physical comfort and individualized nursing with nurses' reported observations of patient participation in care. Nurses described physical comfort, individualized nursing, and safe device use as supporting patients' understanding of their health status and participation in treatment and self-management. The fieldwork component of this dimension therefore reflects nurses' accounts of patient responses rather than direct assessments of patients' perceptions or engagement.

4.4 | Professional Autonomy

The theoretical attributes of clinical interpretability and technical execution manifested in practice as nurses' autonomous judgment, and together they formed the dimension of professional autonomy. The participating nurses were not passive recipients of device-generated information; rather, they actively decided whether, when, and how to apply devices based on patients' conditions. Simultaneously, newly identified concerns regarding responsibility for device malfunctions or adverse events were found to constrain autonomy. These findings indicate that clear legal and institutional safeguards are essential to sustain nurses' professional autonomy regarding device use.

4.5 | Final Definition

Through this integrative process, the final definition of nursing care devices was derived and can be stated as follows.

In this study, nursing care devices are conceptualized as a nursing-specific practice concept referring to technological tools that nurses autonomously select and use, based on professional judgment, to support patient treatment, recovery, safety, and participation in care. The term does not constitute a regulatory category separate from medical devices; rather, it describes how devices—including those classified as medical devices—are integrated into nursing practice through professional judgment. Four core dimensions characterize the concept: technological efficacy, organizational integration, patient engagement, and professional autonomy.

5 | Discussion

This hybrid concept analysis suggests that nursing care devices are not merely machines assisting medical treatment but core tools linking nurses' expertise with patient care. Despite the widespread use of the term "medical device," existing conceptualizations are predominantly grounded in physician-centered, technology-oriented frameworks that prioritize technical performance, regulatory classification, and diagnostic or therapeutic functions. Such perspectives tend to position nurses as secondary operators of devices rather than as primary agents who interpret, adapt, and integrate technology within complex care processes. Consequently, these approaches may inadequately capture the organizational, relational, and judgment-intensive nature of nursing practice, particularly in contexts where continuous monitoring, patient

education, and workflow coordination are central. This study moves beyond conceptual clarification and provides a defining framework that positions nursing care devices as actionable and strategic resources for nursing management.

The present study addresses these limitations by conceptualizing nursing care devices from a nursing-specific practice perspective [20]. From a nursing-specific practice perspective, nurses are positioned as autonomous mediators who integrate technological functions into patient-centered care within organizational systems. By integrating technological efficacy [9] with organizational integration [21], patient engagement [46, 47], and professional autonomy [48], this framework positions devices not merely as tools of clinical intervention but as strategic resources embedded in nursing management systems [9, 17]. This reconceptualization provides a robust theoretical foundation for aligning technology implementation and governance with frontline nursing workflows [11, 49] and for recognizing nurses' roles in shaping safe, efficient, and patient-centered care delivery [19, 48, 50].

Whereas prior digital health research has largely emphasized device performance, this study proposes a four-dimensional conceptualization of nursing care devices comprising technological efficacy, organizational integration, patient engagement, and professional autonomy. This framework reframes devices from passive adjuncts to practice resources embedded within nursing care and organizational systems.

Importantly, nursing care devices should not be understood as a regulatory category separate from medical devices. Rather, the concept provides a nursing-specific practice perspective on how devices, including those classified as medical devices, are integrated into continuous monitoring, patient interaction, and workflow coordination through nurses' professional judgment. This distinction underscores that the defining feature of nursing care devices lies not in their technical characteristics but in their relational and organizational embedding within nursing practice [11].

Existing scholarship has addressed digital nursing through relational and sociotechnical perspectives [51, 52], organizational conditions that shape health-technology implementation [49], and device-related patient-safety concerns such as alarm fatigue [12, 13]. Research on medical-device development has also emphasized the importance of stronger nursing involvement in design and implementation [18]. The present framework does not replace these perspectives; rather, it integrates them within a nursing-specific practice concept organized around technological efficacy, organizational integration, patient engagement, and professional autonomy. Its specific contribution to nursing management is to provide a conceptual structure for examining device selection, implementation, workflow integration, governance, and professional accountability across the device lifecycle.

Building on this conceptualization, the key insights regarding the four core dimensions are as follows. First, the technological efficacy dimension reflects the potential of nursing care devices to reduce physical and cognitive burdens through real-time [3], automated [1, 9], and intelligent functions [9, 32–36]. Across the literature review and fieldwork, devices were reported or described as potentially streamlining clinical documentation [21] and logistical management, as well as supporting earlier recognition of clinical deterioration [53]; however, the present study did not directly evaluate clinical efficiency. Alarm fatigue may increase nurses' workload and cognitive burden [12, 13], and technical and connectivity problems may disrupt device use and nursing workflows [16]. These findings suggest that technological efficacy becomes meaningful only when device functionalities are aligned with the realities of clinical practice and when nurses' experiential knowledge and professional judgment inform both the design and implementation of nursing care devices [2, 48].

Second, the dimension of organizational integration highlights that the effectiveness of nursing care devices depends not only on individual nurses' competence or device performance but also on organizational information systems and infrastructure [9, 11]. Existing research suggests that safe and consistent device use is supported by integration with organizational information systems [21], interprofessional collaboration [11], and alignment with broader organizational processes [17]. Without these conditions, their potential benefits may be limited [7, 15]. For example, technical and connectivity problems in mobile barcode medication administration systems may disrupt nursing workflows and undermine reliable system use [16]. These findings expose the limitations of approaches that frame device usage primarily as an issue of individual skill acquisition [15]; instead, they call for conceptualizing device utilization as a matter of organizational readiness [9] and system-level integration [11]. Organizational integration has thus emerged as a key condition for the sustained adoption and diffusion of nursing care devices [17], enabling them to become part of routine nursing practice rather than merely a technological project [11].

Third, the patient engagement dimension reflects the integration of theoretical literature with nurses' reported observations that nursing care devices may support patients' comfort, understanding, and participation in care. Accordingly, patient engagement in the present framework should be interpreted as a nurse-reported and conceptually derived dimension rather than as a directly measured patient outcome.

In the fieldwork phase, nurses interpreted wearable and monitoring devices as tools that could help patients understand their clinical status and participate in care processes. Contemporary literature similarly highlights communication, interaction, and patient involvement as important aspects of technology-mediated nursing care [47].

This aligns with Watson's [54] caring philosophy, which emphasizes respect for human dignity and agency and views technology as a means rather than an end in itself. Contemporary scholarship similarly highlights communication, presence, trust, and nurse–patient interaction as important elements of caring in technology-mediated nursing practice [47].

Fourth, the dimension of professional autonomy reveals the dual nature of nursing care devices in concurrently expanding nurses' clinical judgment [48, 55] and their responsibility [10, 16, 56]. The nurses who participated in this study perceived devices as tools that they autonomously apply to promote patients' treatment, recovery, and safety [29, 48]. They reported accepting responsibility for device installation, adjustment, and removal, as well as related patient education as part of their role [30],

indicating that devices can act as mediators that enhance professional autonomy—in line with Benner's notion of the "expert" nurse [48, 55]. However, fieldwork data also highlighted concerns that nurses might be held personally accountable for adverse events or device malfunctions [16], suggesting that when autonomy is not matched with institutional and educational support [17], it may become a source of potential stress rather than empowerment [7, 56]. Professional autonomy in this context is defined not only as an expansion of authority but also as a form of ethical knowledge anchored in responsibility [10], education, and supportive structures. For nurses' autonomy to be meaningfully realized, these findings emphasize the necessity of clear legal liability standards, ongoing training, robust safeguards against device malfunction, and the integration of nurses' perspectives into organizational decision-making [9]. Taken together, the four dimensions suggest that nursing care devices transcend the technology-centered perspective common in medical-device research [20]. While previous studies focused on accuracy and clinical effectiveness—often viewing nurses as secondary operators—this study restores the centrality of nurses' agency [48] by conceptualizing these devices as practice tools that mediate professional judgment [10, 50] and caring relationships [10]. Consequently, nursing care devices emerge as elements of a dynamic practice continually reshaped within nurse–patient–organization relationships. Essentially, nursing care devices are social and contextual tools operating at the intersection of Watson's [54] relational caring and Carper's [57] personal knowledge. Contemporary digital nursing scholarship further situates technology within relational networks in which nurses, patients, technologies, and clinical contexts interact to shape nursing practice [51, 52].

5.1 | Limitations

This study has some limitations. The fieldwork phase involved five experienced nurses from a single tertiary hospital. Their extensive clinical experience may have contributed to a greater emphasis on professional autonomy, while the high-acuity, technology-intensive clinical environment may have increased the prominence of device use and related experiences. Therefore, these findings should be interpreted as contextually emphasized characteristics rather than as universal features of nursing care devices. Additionally, the study primarily reflects frontline nurses' perspectives without incorporating views from nurse managers, physicians, or administrators. The patient engagement dimension reflects nurses' accounts of observed patient responses rather than patients' own perspectives or direct measures of engagement; future studies should validate this dimension using patient-reported or behavioral measures. Specifically, future research should investigate nurse managers' leadership roles and perspectives in establishing robust technology governance models to align administrative priorities with clinical workflows. Evaluating the impact of the framework on organizational outcomes, such as workforce sustainability and patient safety, remains critical for longitudinal study.

5.2 | Implications for Nursing Management

This study suggests that nursing care devices should be managed not as isolated technological tools but as integral components of nursing service delivery and organizational systems. From a management perspective, this requires establishing structured technology governance mechanisms in which nurse managers play a central and accountable role in decision-making across the entire device lifecycle, including selection, implementation, evaluation, and ongoing optimization.

At the organizational level, healthcare institutions should develop formal governance structures, such as multidisciplinary technology committees, to define clear selection criteria, standardize evaluation processes, and ensure alignment between device functionality and clinical workflows. Nurse managers should actively contribute to procurement decisions by articulating frontline workflow requirements and patient safety priorities. In addition, device-related tasks—including alarm management, troubleshooting, and data monitoring—should be explicitly recognized within workload measurement systems to prevent hidden labor and mitigate burnout.

At the workforce level, integrating nursing care devices necessitates a shift in role expectations from task-based operations to clinical data interpretation and the coordination of technology-enabled care. This requires nurse managers to lead the development of structured training programs that go beyond technical operation and focus on digital clinical reasoning, critical appraisal of device-generated data, and safe decision-making. Training ownership should be clearly assigned, and ongoing competency assessment systems should be implemented to ensure sustained proficiency.

At the policy level, sustainable implementation requires clear institutional and regulatory frameworks that delineate responsibility and accountability for device-related outcomes. Nurse managers should advocate for policies that formally recognize technology-related nursing work within staffing models and reimbursement systems, and that establish support infrastructures, including technical assistance and pathways for interdisciplinary collaboration. Collectively, these strategies position nursing care devices as managed organizational resources that may support care quality and workforce sustainability in digitally evolving healthcare environments; however, these outcomes require empirical evaluation.

6 | Conclusion

This study provides a management-oriented conceptualization of nursing care devices through four dimensions: technological efficacy, organizational integration, patient engagement, and professional autonomy. This framework positions these devices as core elements of nursing management systems rather than isolated technical tools. The clinical and organizational value of these devices depends on the extent to which nurses' professional judgment is supported by robust organizational structures and leadership. By reframing nurses as active agents, this study provides a conceptual foundation for developing and empirically evaluating technology governance strategies in relation to care quality and organizational performance in digitally evolving healthcare environments.

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Ethics Statement

Ethical approval was obtained from the Keimyung University Academic Ethics Committee (40525 202301 HR 090 04).

Consent

Written informed consent was obtained from all nurse participants prior to data collection.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request. Owing to the nature of qualitative interview data and ethical considerations regarding participant confidentiality, the data are not publicly available.

References

1. A. Abd-Alrazaq, R. AlSaad, D. Alhuwail, et al., "Systematic Review and meta-analysis of Performance of Wearable Artificial Intelligence in Detecting and Predicting Depression," *NPJ Digital Medicine* 6, no. 1 (2023): 84.

2. H. Alzghaibi, "Nurses' Perspectives on AI-enabled Wearable Health Technologies: Opportunities and Challenges in Clinical Practice," *BMC Nursing* 24, no. 1 (2025): 799, https://doi.org/10.1186/s12912-025-03343-y.

3. I. Karpiel, T. Zieliński, P. Pander, and A. Broncel, "Overview of Respiratory Sensor Solutions to Support Patient Diagnosis and Monitoring," *Sensors* 25, no. 4 (2025): 1078, https://doi.org/10.3390/s25041078.

4. A. Avila, J. Claes, K. Goetschalckx, et al., "Home-Based Exercise with Telemonitoring Guidance in Patients with Coronary Artery Disease: Does it Improve long-term Physical Fitness?" *European Journal of Preventive Cardiology* 27, no. 4 (2020): 367–377, https://doi.org/10.1177/2047487319892201.

5. J.-F. Lu, C.-M. Chen, and C.-Y. Hsu, "Effect of Home Telehealth Care on Blood Pressure Control: a Public Healthcare Centre Model," *Journal of Telemedicine and Telecare* 25, no. 1 (2019): 35–45, https://doi.org/10.1177/1357633x17734258.

6. R. W. Treskes, L. A. J. van Winden, N. van Keulen, et al., "Effect of smartphone-enabled Health Monitoring Devices vs Regular follow-up on Blood Pressure Control Among Patients After Myocardial Infarction: a Randomized Clinical Trial," *JAMA Network Open* 3, no. 4 (2020): e202165, https://doi.org/10.1001/jamanetworkopen.2020.2165.

7. S. Kitsiou, G. Paré, M. Jaana, and B. Gerber, "Effectiveness of Mhealth Interventions for Patients with Diabetes: an Overview of Systematic Reviews," *PLoS One* 12, no. 3 (2017): e0173160, https://doi.org/10.1371/journal.pone.0173160.

8. J. Luo, Q. Liu, R. Song, T. W. Yew, and Q. Zhang, "Effectiveness of Wearable Device-based Intervention on Glycemic Control in Patients with Type 2 Diabetes: a System Review and meta-analysis," *Journal of Medical Systems* 46, no. 1 (2021): 11, https://doi.org/10.1007/s10916-021-01797-6.

9. M. Michalowski, M. Topaz, and L. M. Peltonen, "An AI-enabled Nursing Future with No Documentation Burden: a Vision for a New Reality," *Journal of Advanced Nursing* 82, no. 1 (2026): 907–912, https://doi.org/10.1111/jan.16911.

10. A. Falk-Rafael, "Speaking Truth to Power: Nursing's Legacy and Moral Imperative," *Advances in Nursing Science* 28, no. 3 (2005): 212–223, https://doi.org/10.1097/00012272-200507000-00004.

11. R. A. Leahy and E. E. Davenport, "Home Monitoring for Cardiovascular Implantable Electronic Devices: Benefits to Patients and to Their follow-up Clinic," *AACN Advanced Critical Care* 26, no. 4 (2015): 343–355.

12. M. Cvach, "Monitor Alarm Fatigue: an Integrative Review," *Biomedical Instrumentation & Technology* 46, no. 4 (2012): 268–277, https://doi.org/10.2345/0899-8205-46.4.268.

13. E. Kim and M. Kim, "Intensive Care Unit Nurse's Reaction Experience to Patient Monitoring Medical Device Alarms," *Journal of Korean Academy of Nursing Administration* 27, no. 3 (2021): 215–226.

14. V. Burkoski, J. Yoon, S. Solomon, T. N. Hall, and K. Jarvi, "Smartphone Technology: Enabling Prioritization of Patient Needs and Enhancing the nurse-patient Relationship," *Nursing Leadership* 32, no. SP (2019): 29–40.

15. R. M. Jedwab, E. Manias, A. M. Hutchinson, N. Dobroff, and B. Redley, "Nurses' Experiences After Implementation of an Organization-wide Electronic Medical Record: Qualitative Descriptive Study," *JMIR Nursing* 5, no. 1 (2022): e39596, https://doi.org/10.2196/39596.

16. E. Jo, Y. Lee, S. Yoo, S. Lee, and H. J. Yun, "Emergency Nurses' Experiences of Mobile Barcode Medication Administration: Based on the Unified Theory of Acceptance and Use of Technology," *Journal of Qualitative Research* 25, no. 1 (2024): 26–36.

17. T. Risling, "Educating the Nurses of 2025: Technology Trends of the next Decade," *Nurse Education in Practice* 22 (2017): 89–92, https://doi.org/10.1016/j.nepr.2016.12.007.

18. J. Castner, S. S. Sullivan, A. H. Titus, and K. J. Klingman, "Strengthening the Role of Nurses in Medical Device Development," *Journal of Professional Nursing* 32, no. 4 (2016): 300–305, https://doi.org/10.1016/j.profnurs.2016.01.002.

19. H.-A. Park, "Methods of patient-reported Measures Administration and Their Impact," *International Journal for Quality in Health Care* 33, no. 1 (2021): https://doi.org/10.1093/intqhc/mzaa044.

20. L. O. Walker and K. C. Avant, *Strategies for Theory Construction in Nursing*, 5th ed. (Pearson/Prentice Hall, 2011).

21. H. Kim, J. H. Park, Y. H. Kim, and N. Kim, "Developing Geriatric Nursing Competency Using Information and Communication Technology: Focusing on a Case of Depression Assessment," *Journal of Korean Gerontological Nursing* 20, no. Suppl. 1 (2018): 119–126, https://doi.org/10.17079/jkgn.2018.20.s1.s119.

22. World Health Organization, *WHO Global Model Regulatory Framework for Medical Devices Including in Vitro Diagnostic Medical Devices* (World Health Organization, 2017).

23. European Parliament & Council of the European Union, "Regulation (EU) 2017/745 of the European Parliament and of the Council of 5 April 2017 on Medical Devices," *Official Journal of the European Union* 117 (2017): 1–175.

24. D. Schwartz-Barcott and H. S. Kim, "An Expansion and Elaboration of the Hybrid Model of Concept Development," in *Concept Development in Nursing: Foundations, Techniques, and Applications*, 2nd ed., ed. B. L. Rodgers and K. A. Knafl (W.B. Saunders, 2000), 129–159.

25. J. Gunawan, Y. Aungsuroch, and C. Marzilli, "Beyond the Classics: a Comprehensive Look at Concept Analysis Methods in Nursing Education and Research," *Belitung Nursing Journal* 9, no. 5 (2023): 406–410, https://doi.org/10.33546/bnj.2544.

26. M. J. Page, J. E. McKenzie, P. M. Bossuyt, et al., "The PRISMA 2020 Statement: an Updated Guideline for Reporting Systematic Reviews," *BMJ* 372 (2021): n71, https://doi.org/10.1136/bmj.n71.

27. S. Elo and H. Kyngäs, "The Qualitative Content Analysis Process," *Journal of Advanced Nursing* 62, no. 1 (2008): 107–115, https://doi.org/10.1111/j.1365-2648.2007.04569.x.

28. B. G. Glaser and A. L. Strauss, *The Discovery of Grounded Theory: Strategies for Qualitative Research* (Aldine de Gruyter, 1967).

29. H. Xu, X. Zhang, Y. Lu, Y. Wang, and L. Chen, "The Effectiveness of Dressings and Securement Devices to Prevent Central Venous catheter-associated Complications: a Systematic Review and meta-analysis," *International Journal of Nursing Studies* 149 (2024).

30. Y. Wu, L. Wu, and M. Yu, "The Clinical Value of Intelligent Wound Measurement Devices in Patients with Chronic Wounds: a Scoping Review," *International Wound Journal* 21, no. 3 (2024): https://doi.org/10.1111/iwj.14843.

31. H. L. McNeely, C. A. Rauen, and M. B. Bixby, "Utilization of a Biomedical Device (Veinviewer) to Assist with Peripheral Intravenous Catheter (PIV) Insertion for Pediatric Nurses," *Journal for Specialists in Pediatric Nursing* 23, no. 2 (2018).

32. Y.-H. Gu, Y.-J. Wang, L. Zhang, Y.-L. Liu, and T. Zhang, "An Alarm Device for Mechanical Compression Device Displacement at Femoral Artery Puncture Sites," *Minimally Invasive Therapy & Allied Technologies* 32, no. 3 (2023): 91–97, https://doi.org/10.1080/13645706.2023.2175616.

33. S. Schreiber, G. Cozzi, R. Rutigliano, et al., "Analgesia by Cooling Vibration During Venipuncture in Children with Cognitive Impairment," *Acta Paediatrica* 105, no. 1 (2016): e12–e16, https://doi.org/10.1111/apa.13224.

34. L. Batalik, K. Filakova, K. Batalikova, and F. Dosbaba, "Benefits and Effectiveness of Using a Wrist Heart Rate Monitor as a Telerehabilitation Device in Cardiac Patients: a Randomized Controlled Trial," *Medicine* 99, no. 11 (2020).

35. Y. Song, C. Ren, P. Liu, L. Tao, X. Yang, and W. Gao, "Effect of Smartphone-based Telemonitored Exercise Rehabilitation Among Patients with Coronary Heart Disease," *Journal of Cardiovascular Translational Research* 13, no. 4 (2020): 659–667, https://doi.org/10.1007/s12265-019-09938-6.

36. F. Barata, P. Tinschert, F. Rassouli, C. Steurer-Stey, E. Fleisch, and T. Kowatsch, "Nighttime Continuous Contactless Smartphone-based Cough Monitoring for the Ward: Validation Study," *JMIR Formative Research* 7, no. 1 (2023).

37. Y. Choi and H. Y. Ahn, "Axillary Temperature Measurements Based on Smart Wearable Thermometers in South Korean Children: Comparison with Tympanic Temperature Measurements," *Child Health Nursing Research* 28, no. 1 (2022): 62–69, https://doi.org/10.4094/chnr.2022.28.1.62.

38. J.-P. Benigni, S. Sadoun, F. A. Allaert, and F. Vin, "Evaluation of Three Different Devices to Reduce Stasis Edema in Poorly Mobile Nursing Home Patients," *International Angiology: A Journal of the International Union of Angiology* 37, no. 4 (2018): 322–326.

39. G. Ray-Barruel, E. Alexandrou, B. R. Baggio, J. Catterson, and N. Marsh, "Handheld Ultrasound Devices for Peripheral Intravenous Cannulation: a Scoping Review," *Journal of Infusion Nursing* 47, no. 2 (2024): 75–95.

40. M. Gibney, C. H. Arce, K. J. Byron, and L. J. Hirsch, "Reduced Silent Occlusions with a Novel Catheter Infusion Set (BD FlowSmart): Results from Two open-label Comparative Studies," *Diabetes Technology & Therapeutics* 18, no. 3 (2016): 136–143, https://doi.org/10.1089/dia.2015.0342.

41. T. A. Volsko, "Devices Used for CPAP Delivery," *Respiratory Care* 64, no. 6 (2019): 723–734, https://doi.org/10.4187/respcare.06625.

42. W. Bieser, M. Welsch, M. Jakob, et al., "Effectiveness of a New single-needle single-pump Dialysis System with Simultaneous Monitoring of Dialysis Dose," *Artificial Organs* 42, no. 8 (2018): 814–823, https://doi.org/10.1111/aor.13149.

43. M. Anwar Abd EL-Aziz, A. Aly Mahgoub, M. Samy Abbas, A. Talaat Ahmed, and H. Abd Allah Abozeid, "Comparative Study Between the Effect of Intermittent and Hospital Blended Enteral Feeding on Intensive Care Patients' Outcomes," *Egyptian Journal of Health Care* 11, no. 2 (2020): 448–467, https://doi.org/10.21608/ejhc.2020.140542.

44. T. Tran, S. B. Lund, M. D. Nichols, and T. Kummer, "Effect of Two Tourniquet Techniques on Peripheral Intravenous Cannulation Success: a Randomized Controlled Trial," *The American Journal of Emergency Medicine* 37, no. 12 (2019): 2209–2214, https://doi.org/10.1016/j.ajem.2019.03.034.

45. M. L. Taylor, E. E. Thomas, C. L. Snoswell, A. C. Smith, and L. J. Caffery, "Does Remote Patient Monitoring Reduce Acute Care Use? A Systematic Review," *BMJ Open* 11, no. 3 (2021): e040232, https://doi.org/10.1136/bmjopen-2020-040232.

46. C. Yu, W. Dong, Y. Zhao, Y. Liu, and L. Li, "More patient-centered Care, Better Healthcare: the Association Between patient-centered Care and Healthcare Outcomes in Inpatients," *Frontiers in Public Health* 11 (2023).

47. S. Ali, M. Kleib, P. Paul, O. Petrovskaya, and M. Kennedy, "Compassionate Nursing Care and the Use of Digital Health Technologies: a Scoping Review," *International Journal of Nursing Studies* 127 (2022): 104161.

48. N. Jacob, G. J. Bours, M. van Dijk, et al., "Pro-Judge Study: Nurses' Professional Judgement in Nurse Staffing Systems," *Journal of Advanced Nursing* 77, no. 10 (2021): 4226–4233, https://doi.org/10.1111/jan.14921.

49. K. Cresswell and A. Sheikh, "Organizational Issues in the Implementation and Adoption of Health Information Technology Innovations: an Interpretative Review," *International Journal of Medical Informatics* 82, no. 5 (2013): e73–e86, https://doi.org/10.1016/j.ijmedinf.2012.10.007.

50. M. Topaz and L. Pruinelli, "Big Data and Nursing: Implications for the Future," *Studies in Health Technology and Informatics* 232 (2017): 165–171.

51. M. Wynn, L. Garwood-Cross, C. Vasilica, and D. Davis, "Digital Nursing Practice Theory: a Scoping Review and Thematic Analysis," *Journal of Advanced Nursing* 79, no. 11 (2023): 4137–4148, https://doi.org/10.1111/jan.15660.

52. M. Wynn and L. Garwood-Cross, "Reassembling Nursing in the Digital Age: an actor-network Theory Perspective," *Nursing Inquiry* 31, no. 4 (2024): https://doi.org/10.1111/nin.12655.

53. H. Jung, H.-A. Park, and H. Hwang, "Improving Prediction of Fall Risk Using Electronic Health Record Data with Various Types and Sources at Multiple Times," *CIN: Computers, Informatics, Nursing* 38, no. 3 (2020): 157–164, https://doi.org/10.1097/cin.0000000000000561.

54. J. Watson, *Nursing: The Philosophy and Science of Caring* (Brown: Little, 1979).

55. P. Benner, *From Novice to Expert: Excellence and Power in Clinical Nursing Practice* (Addison-Wesley Publishing Company, 1984).

56. A. D. Rao, A. Kumar, and M. McHugh, "Better Nurse Autonomy Decreases the Odds of 30-day Mortality and Failure to Rescue," *Journal of Nursing Scholarship* 49, no. 1 (2017): 73–79, https://doi.org/10.1111/jnu.12267.

57. B. A. Carper, "Fundamental Patterns of Knowing in Nursing," *Advances in Nursing Science* 1, no. 1 (1978): 13–24, https://doi.org/10.1097/00012272-197810000-00004.