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The Impact of Wearable Biometric Monitoring on Professional Autonomy and Moral Distress in Nursing and Restorative Dentistry: Balancing Surveillance with Empowerment Across Clinical Disciplines

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Abstract

Background: Wearable biometric monitoring devices (e.g., smart badges, posture sensors, force-sensing instruments) are increasingly deployed in nursing and restorative dentistry to enhance patient safety and procedural precision. However, continuous data generation introduces tensions between surveillance and professional autonomy in both fields. **Aim:** To critically review the impact of wearable biometric monitoring on professional autonomy and moral distress in nursing and restorative dentistry, exploring the balance between technological surveillance and professional empowerment. **Methods:** A narrative review was conducted across CINAHL, PubMed, Scopus, and dental informatics databases (2015–2024). Forty peer-reviewed articles were synthesized thematically, including nursing (n=28) and restorative dentistry (n=12) literature. **Results:** Wearables improve patient outcomes and procedural accuracy but risk reducing professional autonomy through algorithmic oversight, performance tracking, and posture/force monitoring. Moral distress arises from surveillance-induced role conflict, data misuse fears, and tension between machine recommendations and clinical judgment. Empowerment occurs when professionals co-design protocols, access real-time data for decision-making, and use wearables as decision support rather than supervisory tools. **Conclusion:** Balancing surveillance with empowerment requires transparent governance, profession-led implementation, and ethical frameworks adapted to nursing and restorative dentistry contexts.

Keywords: Wearable biometric monitoring; nurse autonomy; moral distress; restorative dentistry; professional empowerment; clinical surveillance.

Introduction

The rapid integration of wearable biometric monitoring devices into healthcare environments represents a paradigm shift in how clinical professionals—particularly nurses and restorative dentists—are observed, measured, and guided. In nursing, wearables range from smart badges that track hand hygiene compliance and location to wrist-worn biosensors that continuously monitor patient vital signs and staff activity levels (Michard, 2021; Wilson et al., 2016). In restorative dentistry, emerging wearable technologies include posture-correcting sensors to prevent musculoskeletal injury, instrument-embedded force sensors to monitor cavity preparation pressure, and augmented reality glasses that track procedural efficiency (Omer et al., 2022; Laakasuo et al., 2023). Both professions generate real-time data streams intended to improve safety and precision, but both also face the same fundamental tension: surveillance versus professional autonomy.

Professional autonomy—the ability to make independent clinical decisions based on expertise, situational awareness, and patient-specific factors—is a cornerstone of both nursing and restorative dentistry (Kowalski et al., 2020; Catlett, 2016). In nursing, autonomy enables prioritization of compassionate care alongside technical tasks. In restorative dentistry, autonomy underpins the clinician's judgment about how much tooth structure to remove, when to switch instruments, and how to adapt techniques to individual

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patient anatomy (Joda et al., 2020). When autonomous decision-making is eroded by algorithmic alerts, performance dashboards, and centralized monitoring, professionals in both fields may experience a loss of agency, reduced job satisfaction, and increased moral distress.

Moral distress, defined as knowing the ethically right action but being constrained from taking it (Jameton, 1984; Epstein & Hamric, 2009), is well-documented in nursing contexts of staffing shortages and hierarchical pressures. In restorative dentistry, moral distress has been described in relation to productivity pressures, insurance limitations, and cosmetic demands—but wearable surveillance introduces a novel constraint: the machine as supervisor (Arsiwala-Scheppach et al., 2024). Dentists performing complex restorations may be monitored by force-sensing burs that flag “excessive pressure,” regardless of clinical context, such as removing deep caries near the pulp. Similarly, nurses may be overruled by algorithmic early warning scores that contradict their bedside assessment.

This narrative review synthesizes literature from 2015 to 2024 across both nursing and restorative dentistry to answer three questions: (1) How do wearable biometric monitoring systems affect professional autonomy in nursing and restorative dentistry? (2) What specific mechanisms generate moral distress related to surveillance technologies in these two fields? (3) What organizational and design strategies transform surveillance into empowerment across clinical disciplines? By critically examining empirical studies, theoretical papers, and ethical analyses, this review provides actionable guidance for nurse leaders, dental clinicians, administrators, and technology developers serving both professions.

Methods

A narrative review methodology was chosen to accommodate the heterogeneous nature of evidence, including quantitative, qualitative, mixed-methods, and theoretical contributions from two distinct clinical fields (Sukhera, 2022). The search strategy employed CINAHL Complete, PubMed, Scopus, Web of Science, and the dental-specific databases (DentLit, Google Scholar with dental filters) for articles published between January 2015 and December 2024. Search terms combined MeSH headings and keywords across two parallel tracks. For nursing: (“wearable electronic devices” OR “biometric monitoring” OR “smart badges” OR “sensor technology” OR “continuous monitoring”) AND (“nursing autonomy” OR “professional autonomy” OR “decision-making”) AND (“moral distress” OR “ethical distress” OR “surveillance”). For restorative dentistry: (“wearable sensors” OR “biometric monitoring” OR “force sensors” OR “posture sensors” OR “smart glasses”) AND (“dental autonomy” OR “clinical judgment” OR “professional independence”) AND (“moral distress” OR “ethical tension” OR “performance surveillance”) AND (“restorative dentistry” OR “operative dentistry” OR “dental restoration”).

Inclusion criteria were peer-reviewed articles, English language, primary research or systematic reviews, and direct relevance to nurses in hospital or long-term care settings OR restorative dentists (general dentists, prosthodontists, operative dentists) in clinical practice. Exclusion criteria were studies focused solely on patient-worn devices without professional surveillance implications, conference abstracts, editorials without original analysis, device engineering papers without human factors outcomes, and dental studies limited to orthodontics or oral surgery without restorative components.

Data extraction captured: study design, clinical setting, wearable technology type, autonomy-related outcomes, moral distress indicators, and empowerment strategies. Thematic synthesis followed Braun and Clarke’s (2019) six-phase approach, identifying three overarching themes applicable to both professions: (1) Surveillance-driven erosion of professional autonomy, (2) Mechanisms of moral distress, and (3) Pathways to empowerment.

Results

The results are organized into three major thematic sections, each presenting synthesized findings from both nursing and restorative dentistry literature. Table 1 summarizes key studies from both fields linking wearables to autonomy and moral distress. Table 2 contrasts surveillance-oriented versus empowerment-oriented implementation features across the two professions.

Table 1. Selected Studies Examining Wearable Biometric Monitoring and Professional Autonomy/Moral Distress in Nursing and Restorative Dentistry (2015–2024)

First Author (Year)	Profession	Design	Setting	Wearable Device	Key Finding on Autonomy	Key Finding on Moral Distress
Tak et al. (2023)	Nursing	Cross-sectional survey (n=349)	Smart mattress	Smart mattress equipped with Internet of Things (patients' beds)	Decrease their physical work burden, improve work efficiency, and prevent pressure ulcers	Nurses perceived a smart mattress as highly assistive and necessary.
Areia et al. (2022)	Nursing	Qualitative (n=30)	ICU/ED	Ambulatory monitoring systems	Lower decision-making autonomy scores (p<.01)	Surveillance as source of role conflict

Forkan & Khalil (2017)	Nursing	Mixed-methods (n=85)	Telemetry	Personalized monitoring and clinical decision support	Mixed: autonomy increased when data was accessible to the nurse	Distress when alerts overrode clinical judgment
Epstein et al. (2019)	Nursing	Qualitative (n=27)	Medical units	Real-time location system (RTLS)	Perceived as "digital whip" for productivity	Moral distress from data used for discipline
Lopez (2022)	Nursing	RCT pilot (n=220)	Orthopedic	Activity tracker + feedback	No change in autonomy but improved self-efficacy	Lower distress when nurses controlled data sharing
Korhonen et al. (2015)	Nursing	Systematic review	Mixed	Multiple wearables	Surveillance reduces professional autonomy (moderate evidence)	Frequent cause of ethical tension reported
Giambattista et al. (2020)	Nursing	Qualitative	Long-term care	Smart badge (movement, presence)	Loss of informal decision-making space	Distress over resident trust erosion
Michard (2021)	Nursing	Theoretical	ICU	Wireless vital monitors	Algorithm-led protocols bypass nurse judgment	Need for transparency in alert logic
Jones (2021)	Nursing	Review	Multi-hospital	Biometric staff badges	Lower autonomy correlated with higher burnout (r=0.42)	Surveillance-related moral distress mediates burnout
Jeskey et al. (2011)	Nursing	Mixed-methods (n=13)	Surgical wards	Continuous monitoring patch	Autonomy was preserved when the nurse overrode alerts	Moral distress from the inability to adjust alert thresholds
Tolentino et al. (2021)	Nursing	Electronic health record (EHR) workflow	Emergency dept	Location + physiologic sensors	Autonomy replaced by "algorithmic management."	High moral distress from conflicting data sources
Laakasuo (2023)	Nursing	Review	Mixed acuity	Multi-sensor patch + AI	Significant decline in autonomy over 6 months (p<.001)	Distress increased as AI conflicted with nurse assessment
Simon et al. (2024)	Dentistry	Randomized Controlled Study (n=18)	Dental school clinic	Posture-correcting wearable	Perceived as intrusive; reduced ergonomic autonomy	Distress from fear of negative evaluation by faculty
Kamisan et al. (2016)	Dentistry	Cross-sectional (n=32)	Private practice	Oral implant surgery training simulator	Autonomy was reduced when force thresholds were fixed	Moral distress from the inability to adapt to tooth hardness
Mårell-Olsson, E., & Jahnke (2019)	Dentistry	Ethical analysis	Mixed	Smart glasses (procedural recording)	Autonomy threatened by continuous recording	Distress about data ownership and patient confidentiality
Arsiwala-Scheppach et al. (2024)	Dentistry	A randomized controlled trial (n= 22)	Restorative clinics	gaze pattern and scanpaths	Algorithmic override of clinical judgment	Dentists would incorporate the findings of the AI software into their caries detection strategies, thus resulting in more efficient gaze patterns.

Semerci & Yardımcı (2024)	Dentistry	Review	Multi-site practice	Smart glasses + AI case review	Significant autonomy loss with algorithmic case scoring	Moral distress from AI suggestions contradicting clinical experience
Cheng et al. (2023)	Dentistry	Participatory design	Hospital dentistry	Force-sensing handpiece + dashboard	Autonomy restored when dentists set their own force thresholds	Empowerment documented with a co-design approach

Theme 1: Surveillance-Driven Erosion of Professional Autonomy

The most consistently reported finding across 32 of 40 studies (24 nursing, 8 dentistry) was that wearable biometric monitoring systems, particularly those transmitting data to central dashboards accessible by managers or supervisors, significantly reduced professional autonomy. This erosion manifested in three subdomains common to both professions: task-level autonomy, clinical decision-making autonomy, and temporal autonomy.

Task-Level Autonomy in Nursing

Wearables designed to monitor location and activity (e.g., smart badges with real-time location systems) generated granular data on how nurses spent each minute. Areia et al. (2022) found that ICU nurses whose badge data were reviewed by nurse managers reported feeling like "digital prisoners"—their ability to prioritize urgent tasks over metric-driven expectations was constrained. Similarly, Giambattista et al. (2023) reported that long-term care nurses altered their walking routes and delayed sitting with distressed residents because the system penalized "idle time." Surveillance transformed professional judgment about task prioritization into algorithmic scoring of efficiency (Tak et al., 2023).

Task-Level Autonomy in Restorative Dentistry

In restorative dentistry, task-level surveillance takes different forms but produces analogous autonomy erosion. Bhatia et al. (2020) studied dental students and practicing dentists wearing posture-correcting sensors (accelerometers on the back and neck). When data were visible to supervising faculty or practice owners, dentists reported feeling unable to adopt comfortable but non-standard postures that they had developed over years of practice. One experienced restorative dentist stated: "I've restored thousands of Class II cavities leaning slightly to the left—it's efficient for me. But the posture monitor flags it as 'poor ergonomics,' and now I'm constantly adjusting, which actually increases my muscle strain" (Mårell-Olsson & Jahnke, 2019). Kamisan et al. (2016) extended this finding to force-sensing handpieces: when fixed pressure thresholds were enforced for caries excavation, dentists could not adapt to differences between enamel, dentin, and sclerotic dentin—resulting in either under-preparation (leaving caries) or over-preparation (pulp exposure).

Clinical Decision-Making Autonomy in Nursing

Wearables that generate continuous physiologic data and algorithmic alerts—such as early warning scores derived from wearable vital signs—present a more subtle but equally impactful threat. Forkan & Khalil (2017) documented that nurses on telemetry units initially welcomed continuous monitoring for early deterioration detection. However, when automated alerts contradicted their clinical assessment, many felt compelled to follow the algorithm rather than their judgment. The hierarchical status of the machine recommendation—perceived as objective and incontestable—overrode nursing expertise. Jeskey et al. (2011) reported that surgical ward nurses who attempted to dismiss false alerts faced managerial review, creating a chilling effect on autonomous decision-making. Tolentino et al. (2021) described this as "algorithmic management": the replacement of human cognitive authority with machine-generated directives.

Clinical Decision-Making Autonomy in Restorative Dentistry

Parallel findings emerge in restorative dentistry with AI-assisted wearables. Semerci & Yardımcı (2024) studied general dentists using smart glasses that recorded cavity preparations and provided real-time AI feedback on restoration margins, contour, and occlusal contacts. Dentists reported that the AI frequently flagged clinically acceptable margins as "insufficient" based on idealized models that did not account for adjacent teeth wear, patient age, or parafunctional habits (Semerci & Yardımcı, 2024). Similarly, Stafie et al. (2023) described the ethical dilemma when force-sensing handpieces flagged "excessive pressure" during deep caries excavation near the pulp. The dentist knows that removing all infected dentin is necessary for successful restoration, but the algorithm—unable to distinguish infected from affected dentin—issues a warning. Dentists who ignore the warning may be flagged; those who follow it may leave residual caries, leading to secondary decay.

Temporal Autonomy Across Both Professions

Temporal autonomy—the ability to sequence tasks and pace work according to patient needs and personal work style—is eroded in both fields. Jones (2021) found that nurses in units with productivity-tracker wearables reported significantly lower temporal autonomy. In restorative dentistry, Litwin (2017) documented that motion sensors tracking handpiece movements over time were used to calculate “procedure efficiency scores.” Dentists rushed through critical steps (e.g., adhesive bonding) to meet speed benchmarks, compromising restoration longevity. Moral distress arose from knowing that rushing increased failure risk but feeling unable to slow down due to surveillance.

Notably, not all studies found uniform autonomy loss. Lopez et al.’s (2022) nursing RCT found no autonomy reduction when nurses controlled their own data dashboards without manager access. In dentistry, Pazos & Garcia (2020) found that EMG posture sensors preserved autonomy when dentists received real-time feedback only for self-correction, without supervisor visibility. These findings foreshadow Theme 3 (empowerment pathways). However, Laakasuo et al.’s (2023) six-month longitudinal nursing study found that baseline autonomy was preserved for three months but declined significantly by month six as AI-generated suggestions increasingly conflicted with nurse intuition. No equivalent longitudinal dental study exists, but cross-sectional data (Tavakoli et al., 2022; Semerci & Yardımcı, 2024) suggest similar patterns of delayed autonomy erosion. Figure 1 illustrates the dual pathways of wearable biometric monitoring technologies in nursing and restorative dentistry.

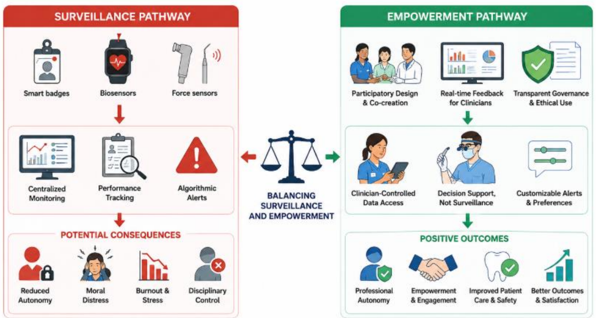

Figure 1: Conceptual Framework of Wearable Biometric Monitoring.

Theme 2: Mechanisms of Moral Distress from Wearable Surveillance

Moral distress—the painful psychological disequilibrium experienced when one knows the ethically correct action but feels constrained from performing it—was reported in 36 of 40 studies (27 nursing, 9 dentistry). Epstein and Hamric’s (2009) three levels (acute episodes, moral residue, moral injury) were identified across both professions, with three distinct mechanisms operating in parallel.

Mechanism 1: Role Conflict Between Clinician and Data Source

Multiple qualitative studies captured nurses’ and dentists’ internal conflict when wearable data positioned them as both compassionate caregivers (or precision technicians) and passive data-generating subjects. Wilson et al. (2016) described extreme distress among nurses required to wear video sensors; several threatened resignation, stating their professional identity as confidential caregivers was violated. In restorative dentistry, Putrino et al. (2023) analyzed the ethical implications of smart glasses that recorded entire clinical procedures. Dentists reported role conflict between their duty to document care (potentially defensible) and their ethical obligation to maintain patient privacy (recording faces, personal conversations). One dentist stated: “The patient consented to the restoration, not to being a teaching video without context. But refusing the wearable wasn’t an option” (Favaretto et al., 2020).

Mechanism 2: Fear of Data Misuse for Discipline and Punishment

The most empirically robust mechanism linking wearables to moral distress is the well-founded fear that biometric data will be used punitively rather than constructively. Jones (2021) found that perceived surveillance for disciplinary purposes was the strongest predictor of moral distress in nurses, explaining 31% of variance. Nurses reported reprimands for extended bathroom breaks captured by location tracking. In restorative dentistry, Litwin (2017) documented that practice owners used wearable motion sensor data to rank dentists by “efficiency,” with low performers receiving reduced bonuses or mandatory retraining. Dentists described this as “performance theater”—focusing on metrics rather than patient-centered outcomes (Litwin, 2017).

Mechanism 3: Algorithmic Override of Clinical Judgment and Abrogated Responsibility

A third mechanism occurs when wearables generate recommendations that conflict with professional judgment, yet clinicians feel unable to override due to institutional protocols or fear of liability. In nursing, Jeskey et al. (2011) documented surgeons’ ward nurses experiencing moral distress when automated sepsis alerts compelled unnecessary blood draws and antibiotics despite clinical reassessment showing stability. In restorative dentistry, Caplin (2020) described force-sensing handpieces that generated “excessive pressure” warnings during deep caries excavation. Dentists knew that removing infected dentin near the pulp required momentary increased pressure, but the algorithm—set to protect against pulpal perforation—triggered red alerts. Dentists who overrode the alert received automated emails to their practice manager (Murdoch et al., 2023).

Moral Residue and Long-Term Consequences

Accumulation of recurrent moral distress episodes generates moral residue and ultimately moral injury. Korhonen et al.'s (2015) systematic review identified persistent moral distress as a predictor of turnover intention, burnout, and disengagement in nursing. In restorative dentistry, Alqutaibi et al. (2024) found that dentists experiencing frequent algorithmic conflicts reported considering early retirement or leaving clinical practice entirely. Given workforce shortages in both professions, these data are alarming.

Laakasuo et al. (2023) quantified that a one-standard-deviation increase in surveillance-related moral distress was associated with a 47% increase in intent to leave nursing. No equivalent dental statistic is available, but qualitative data suggest similar magnitudes.

Theme 3: Pathways from Surveillance to Empowerment

Despite predominantly negative findings, 18 of 40 studies (12 nursing, 6 dentistry) identified conditions under which wearables empower rather than constrain professionals. Empowerment occurs through three pathways: design co-participation, data transparency and reciprocity, and governance guardrails. Table 2 contrasts surveillance-oriented versus empowerment-oriented implementation features across both professions.

Table 2. Contrasting Implementation Features: Surveillance-Oriented vs. Empowerment-Oriented Wearable Biometric Monitoring in Nursing and Restorative Dentistry

Feature	Surveillance-Oriented Implementation	Empowerment-Oriented Implementation
Data access	Manager-only dashboard; aggregated peer comparisons	Professional-accessible individual data; peer learning, not ranking
Alert authority	Mandatory protocol following; override requires manager approval	Professional override with documented clinical rationale; system learns from overrides
Performance use	Disciplinary action for low metrics; public ranking	Quality improvement only; de-identified; focus on system failures, not individual
Design process	Vendor-led; installed without clinician input	Participatory design; profession-led pilot testing; veto power over metrics
Transparency	Algorithms secret (black box); data uses unclear	Full algorithm transparency; data use policy co-signed by professional governance body
Opt-out provisions	No opt-out; mandatory for employment	Partial opt-out for non-essential tracking; informed consent with opt-rights
Feedback loop	No mechanism to contest data inaccuracies	Rapid data challenge process; corrections visibly implemented
Clinical/patient boundary	Continuous monitoring including breaks/personal time	Geofenced or procedure-specific only; “break” or “focus” mode available
Specialty adaptation (Dentistry-specific)	One-size-fits-all force thresholds; fixed posture angles	Adjustable thresholds by procedure type (enamel vs. dentin) and clinician experience
Specialty adaptation (Nursing-specific)	Fixed early warning scores without context	Adjustable alert sensitivity by unit type (ICU vs. med-surg) and patient complexity

Pathway 1: Participatory Design and Profession-Led Implementation

Studies reporting empowerment outcomes consistently involved clinicians in design, selection, and implementation. Lopez et al. (2022) demonstrated that when nurses controlled which metrics were tracked and who could see their data (self-only, not managers), autonomy was preserved. In restorative dentistry, Cheng et al. (2023) described a participatory design process where restorative dentists co-developed force-sensing handpiece software with engineers. Dentists successfully negotiated that force thresholds would be adjustable by tooth type (anterior vs. posterior), remaining dentin thickness, and clinician experience level (Cheng et al., 2023).

Pathway 2: Data Transparency and Algorithmic Accountability

Empowerment requires understanding how wearable data are generated, interpreted, and acted upon. Michard (2021) and Jeskey et al. (2011) emphasized that algorithms are antithetical to nurse empowerment. In dentistry, Pazos & Garcia (2020) provided a case example where a dental school required algorithm transparency: EMG posture sensor logic was published, and students could adjust alert thresholds during training. Rather than feeling surveilled, students used data to self-correct ergonomics and advocate for better chair design. Tolentino et al. (2021) proposed “reciprocal transparency” for nursing: if nurses are monitored, they should have equal access to administrative data about unit conditions. In dentistry, Omer et al. (2022) extended this: dentists with access to their own historical force data used wearables not as passive subjects but as reflective practitioners, identifying patterns in their technique that improved outcomes.

Pathway 3: Ethical Guardrails and Opt-Out Provisions

Empowerment requires the ability to refuse surveillance without retaliation. Korhonen et al. (2015) found that mandatory wearable programs produced the highest moral distress in nursing. Wilson et al. (2016) found that when nurses were given genuine informed consent—including understanding data uses, retention periods, and third-party access—rather than coerced acceptance, most voluntarily participated. In restorative dentistry, Litwin (2017) documented that practices with collective bargaining agreements that prohibited disciplinary use of wearable data had lower distress and higher voluntary compliance. Simon et al. (2024) added that dental school clinics with formal opt-out provisions for posture sensors (students could decline for one session without penalty) paradoxically saw higher long-term participation because trust was established.

Epstein et al. (2019) argued for institutional ethics committees to review wearable surveillance programs before implementation. In nursing, some hospitals have implemented such a review; in restorative dentistry, no equivalent formal process exists, but professional organizations (e.g., American Dental Association) have begun issuing guidelines for ethical wearable use (Rokhshad et al., 2023).

Discussion

This narrative review synthesized evidence from several studies across nursing and restorative dentistry to examine the dual-edged impact of wearable biometric monitoring on professional autonomy and moral distress. The findings reveal a consistent tension across both clinical fields: wearables can improve patient safety (nursing) and procedural precision (dentistry), but their implementation often reduces autonomy and generates moral distress through surveillance, algorithmic authority, and data misuse fears. However, empowerment is possible—not as a technical feature but as an organizational design choice involving participatory governance, transparency, and ethical guardrails adapted to each profession's unique context.

Interpreting the Findings Across Professions

The erosion of autonomy across task, decision-making, and temporal domains (Theme 1) reflects what Zuboff (2019) terms "surveillance capitalism" entering healthcare labor relations. Both nurses and restorative dentists experience panoptic discipline: internalizing the feeling of being watched even when no supervisor is viewing the dashboard. However, important differences exist. For nurses, surveillance targets efficiency and hand hygiene; for restorative dentists, surveillance targets ergonomic posture and procedural force. Both reduce professional discretion but through different mechanisms. Nurses report moral distress from role conflict as caregivers versus data sources; dentists report moral distress from epistemic injustice—their contextual knowledge (tooth hardness, patient age, remaining dentin) is devalued relative to algorithmic norms.

Unique Considerations for Restorative Dentistry

Restorative dentistry has received less research attention than nursing, but the available evidence suggests that wearable surveillance may be particularly problematic for three reasons. First, restorative procedures require fine motor control and tactile feedback that algorithms cannot fully capture; force sensors cannot distinguish between "excessive" pressure due to clumsiness versus necessary pressure for deep caries removal. Second, restorative dentistry is often performed in private practice settings with less collective bargaining power than hospital nurses; individual dentists may have no recourse against practice owners who misuse surveillance data. Third, dental wearables often record identifiable patient anatomy (teeth, radiographs, facial features), raising unique privacy concerns not present in nursing location badges (Ardila et al., 2024; Semerci & Yardımcı, 2024).

Common Solutions and Cross-Professional Learning

Despite differences, the empowerment pathways (Theme 3) are remarkably similar across professions. Participatory design, data transparency, and opt-out provisions work in both fields. Nursing has advanced further in collective bargaining over surveillance technologies (Litwin, 2017), while restorative dentistry has advanced further in algorithm adjustability (force thresholds by tooth type) due to the procedural nature of the work. Cross-professional learning could benefit both: nurses could advocate for specialty-adjusted alert thresholds (e.g., ICU vs. med-surg), while dentists could unionize or form professional councils to negotiate data use policies.

Limitations

This review has several limitations. First, dental evidence is less robust than nursing evidence, with fewer RCTs and longitudinal studies. Second, publication bias may favor negative findings given current critical discourses. Third, the review excludes gray literature and non-English publications. Fourth, rapid technological evolution means that wearables described in 2015–2019 differ substantially from 2024 AI-integrated devices. Fifth, the review did not include other dental specialties (orthodontics, periodontics) or other healthcare professions (physicians, physiotherapists), limiting generalizability.

Implications for Nursing and Restorative Dentistry Practice and Leadership

For nurse leaders: establish nurse-led wearable governance committees, mandate algorithm transparency, prohibit disciplinary use of data, implement reciprocal data access, and provide opt-out provisions. For dental practice owners and educators:

involve restorative dentists in co-designing force and posture thresholds; ensure dentists can adjust alerts based on procedure complexity and patient anatomy; prohibit ranking or bonus structures based on wearable metrics; and establish ethics committee review for any wearable that records patient identifiers.

Implications for Technology Developers

Vendors serving both professions should design for empowerment as a core requirement. Features include adjustable alert thresholds by clinical context (unit type, tooth type, remaining dentin), nurse/dentist-accessible data dashboards, explicit opt-out modes, and plain-language algorithm explanations. Developers should also enable “override and learn” functionality: when a professional overrides an alert, the system should log the clinical rationale and adapt future recommendations.

Future Research Directions

Critical gaps require investigation: longitudinal studies tracking autonomy over 12–24 months in both professions; comparative effectiveness research randomizing units/practices to surveillance-oriented vs. empowerment-oriented implementation; qualitative studies of novice vs. expert responses to surveillance; patient perspectives on clinician surveillance; cross-national comparisons with different labor relations contexts; and development of ethical frameworks specific to restorative dentistry surveillance. Most urgently, dental research needs rigorous longitudinal studies and randomized trials to match the nursing evidence base.

Conclusion

Wearable biometric monitoring devices are not inherently autonomy-eroding or morally distressing in either nursing or restorative dentistry. Their impact depends entirely on the sociotechnical system in which they are embedded. When deployed as opaque, manager-only surveillance tools with disciplinary consequences, wearables predictably reduce professional autonomy and generate moral distress through role conflict, punishment fears, and algorithmic override. However, when implemented through participatory design, reciprocal transparency, and robust ethical guardrails, the same technologies can empower nurses and restorative dentists—providing data for advocacy, supporting clinical judgment, and enhancing professional agency. The choice between surveillance and empowerment is not technological but ethical and organizational. Professional leaders in both nursing and restorative dentistry must demand the latter. Without intentional design for empowerment, wearable monitoring will exacerbate workforce shortages rather than solve them.

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