



Reproductive Toxicants in the Workplace: Bridging Evidence, Regulation, and Occupational Nursing Practice in the Era of Bisphenol A

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The growing recognition of endocrine-disrupting chemicals (EDCs) as critical determinants of occupational health has marked a paradigm shift in workplace risk assessment and prevention. Among these agents, Bisphenol A (BPA) has emerged as a paradigmatic example of a ubiquitous chemical with profound implications for reproductive health. The accompanying article by De-Pedro-Jiménez et al. provides a timely and rigorous interpretative analysis of BPA as a reprotoxic agent, highlighting not only its biological effects but also its practical implications for Occupational Health Nursing.

This editorial seeks to contextualize these findings within the broader framework of occupational hygiene, emphasizing the urgent need to integrate scientific evidence, regulatory evolution, and nursing practice. It argues that BPA exposure is not merely a toxicological concern but a call to redefine preventive strategies, strengthen health surveillance, and consolidate the leadership role of occupational nurses in addressing emerging reproductive risks.

Bisphenol A and the New Landscape of Occupational Risk

BPA is one of the most extensively produced industrial chemicals worldwide, widely used in polycarbonates, epoxy resins, and thermal paper. Its ubiquitous presence in occupational settings translates into chronic, low-dose exposure among workers in manufacturing, healthcare, and service industries. Biomonitoring studies have consistently demonstrated detectable BPA levels in human biological samples, underscoring the near-universal nature of exposure¹.

What distinguishes BPA from traditional occupational hazards is its mechanism of action. As an endocrine disruptor, BPA interferes with hormonal homeostasis through non-monotonic dose-response relationships, challenging classical toxicological assumptions. Evidence from systematic reviews and meta-analyses has established its association with impaired fertility, altered gametogenesis, adverse pregnancy outcomes, and developmental abnormalities²⁻⁴.

These findings are particularly relevant in occupational settings, where exposure may be continuous and combined with other chemical stressors. The article by De Pedro-Jiménez et al.



effectively translates this body of evidence into a clinically meaningful framework for Occupational Nursing, identifying key domains such as reproductive surveillance, symptom detection, and preventive education.

Regulatory Advances and Persistent Gaps

The regulatory landscape in Europe has evolved significantly in response to mounting evidence on BPA toxicity. The recent update of RD 665/1997 through RD 612/2024 represents a milestone by explicitly incorporating protection against reprotoxic agents. This regulatory shift acknowledges that reproductive health is an essential component of occupational safety.

However, as highlighted in the accompanying article, a critical gap persists between regulation and practice. While legislation defines obligations and exposure limits, it often lacks operational guidance for implementation in clinical and workplace settings. In particular, standardized protocols for reproductive health surveillance in workers exposed to EDCs remain underdeveloped.

This gap is not unique to BPA. It reflects a broader challenge in occupational hygiene: the difficulty of translating complex, evolving scientific evidence into actionable preventive measures. Bridging this gap requires interdisciplinary collaboration, where Occupational Nursing plays a central role.

Occupational Hygiene Revisited: From Exposure Control to Reproductive Protection

Traditional occupational hygiene has focused on identifying hazards, assessing exposure, and implementing control measures such as engineering controls, personal protective equipment (PPE), and environmental monitoring. While these principles remain essential, they are insufficient to address the complexities of EDC exposure.

BPA exemplifies the limitations of conventional approaches. Its multiple routes of exposure (dermal, inhalational, oral), its presence in both occupational and non-occupational environments, and its subtle, long-term effects on reproductive health necessitate a more holistic perspective.



A modern approach to occupational hygiene must incorporate:

1. **Biomonitoring strategies** to assess internal dose and cumulative exposure^{5,6}.
2. **Life-course perspective**, recognizing critical windows of vulnerability such as preconception, pregnancy, and lactation.
3. **Integration of reproductive health indicators** into routine surveillance.
4. **Worker-centered education**, addressing both workplace and lifestyle exposures.

The interpretative framework proposed by De-Pedro-Jiménez et al. aligns with these principles, offering a structured approach that bridges environmental monitoring and clinical practice.

The Strategic Role of Occupational Health Nursing

Occupational nurses are uniquely positioned at the intersection of clinical care, prevention, and workplace reality. Their role extends beyond traditional health assessments to encompass early detection, risk communication, and behavioral interventions.

The four thematic categories identified in the BPA article—reproductive surveillance, protection during exposure, detection of endocrine disruption, and health education—reflect core nursing competencies. These domains underscore several key contributions:

- **Early identification of risk:** Through detailed reproductive histories and symptom assessment, nurses can detect subtle changes that may indicate endocrine disruption.
- **Continuity of care:** Nurses often maintain longitudinal relationships with workers, facilitating ongoing monitoring and trust-based communication.
- **Health education:** Effective risk communication is essential in the context of invisible and poorly understood hazards such as BPA.
- **Advocacy and coordination:** Nurses can advocate for workplace adaptations, including job reassignment during pregnancy or enhanced protective measures.

Despite this strategic position, evidence suggests that knowledge and awareness of BPA among healthcare professionals remain limited⁷. This highlights the need for targeted training and capacity building within Occupational Nursing.



From Evidence to Practice: Operationalizing Reproductive Health Surveillance

One of the most significant contributions of the accompanying article is its translation of scientific evidence into practical nursing interventions. However, the implementation of these recommendations requires systemic support.

Key priorities for operationalization include:

1. **Development of standardized protocols:** Incorporating reproductive health indicators into routine occupational health assessments.
2. **Training programs:** Enhancing competencies in endocrine disruption, biomonitoring, and risk communication.
3. **Interdisciplinary collaboration:** Integrating nursing practice with occupational medicine, industrial hygiene, and toxicology.
4. **Research in real-world settings:** Validating proposed interventions through workplace-based studies.

The need for such integration is supported by broader calls in the scientific community to prioritize reproductive health within safety culture⁸. BPA serves as a catalyst for advancing this agenda.

Challenges and Future Directions

Addressing BPA exposure in occupational settings presents several challenges:

- **Scientific uncertainty:** Non-monotonic dose-response relationships complicate risk assessment.
- **Exposure complexity:** Combined exposures to multiple EDCs may produce additive or synergistic effects.
- **Regulatory lag:** Legislation often evolves more slowly than scientific evidence.
- **Resource constraints:** Implementing comprehensive surveillance programs may be challenging in certain settings.

Despite these challenges, the direction is clear. Occupational health must evolve toward a preventive, evidence-based, and worker-centered model that fully integrates reproductive health.



Future research should focus on:

- Longitudinal studies of occupational exposure and reproductive outcomes.
- Validation of nursing-led surveillance models.
- Development of biomarkers for early detection of endocrine disruption.
- Evaluation of intervention effectiveness in reducing exposure and improving health outcomes.

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