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**SUDDEN INFANT DEATH SYNDROME AND PLASTIC BEDDING
MATERIALS: A SYSTEMATIC REVIEW OF AUTOPSY EVIDENCE
LINKING VOC OFF-GASSING, CARBON DIOXIDE REBREATHING, AND
THERMAL STRESS TO PATHOPHYSIOLOGICAL MECHANISMS**

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Abstract. *This comprehensive study investigates the mechanistic relationship between plastic bedding materials and Sudden Infant Death Syndrome (SIDS) through systematic analysis of autopsy evidence spanning 55 years. The investigation reveals that three autopsy findings remain constant across SIDS cases: thoracic petechiae (85%), pulmonary congestion (85%), and pulmonary oedema (62%). This research identifies three bedding-related stress factors that create this physiological response: (i) volatile organic compounds (VOCs) released from plastics and flame-retardant foam materials causing respiratory irritation and neurological depression; (ii) carbon dioxide accumulation occurring with impermeable bed covers leading to hypercapnia and subsequent apnoea; and (iii) heat retention elevating core temperature, increasing oxygen demand while suppressing arousal mechanisms. Cross-national epidemiological analysis demonstrates that nations implementing breathable bedding standards including Italy (0.08‰ by 2022), Denmark (0.10‰ by 2020), Slovenia (0.05‰), and New Zealand (zero deaths in wrapped mattresses) achieved substantially greater SIDS reductions than the United States (plateaued at 0.42‰), which maintained plastic bedding despite back-to-sleep campaigns. The integrated pathophysiological model presented reconciles previously unexplained autopsy lesions with environmental exposures, providing evidence-based recommendations for manufacturing standards, hospital procurement protocols, and public health guidance to close the remaining preventable gap in SIDS mortality.*

Introduction.

Sudden infant death syndrome (SIDS) remains the principal cause of post-neonatal mortality in industrialised nations [9]. The 1994 U.S. Back-to-Sleep campaign halved deaths, yet the rate plateaued at 0.42‰ by 2022 [10]. Countries that replaced plastic bedding with breathable fibre now report markedly lower rates: Italy's 1999 materasso rigido e piano policy coincided with a fall from ~1‰ in the 1970s to 0.08‰ in 2022; Denmark's 1998 polyurethane-pad ban yielded a decline to

0.10‰ by 2020 [8]; and Slovenia, where hay- or cotton-filled mattresses are customary, records just 0.05‰ [9]. Converging toxicological, microbiological and physiological evidence indicates that plastic-encased crib mattresses act as a nexus for VOC emission, CO₂ trapping and heat retention stressors that reproduce the hypoxic, congestive and neuro-gliotic footprints documented at autopsy [3,5,7]. This study integrates neonatal anatomy, foam mattress microbiology, emission and heat data, and five-nation mortality trends to test the plastic-bedding hypothesis within the triple-risk framework.

Main text.

PubMed and Google Scholar (1970-2025) were searched with terms SIDS, mattress, off-gassing, CO₂ rebreathing, hyperthermia, mattress microbiology, serotonin brainstem, and national trend data. Twenty-five sources met review criteria: 8 emission/toxicology studies, 4 experimental/mannequin trials, 8 autopsy/pathophysiology investigations, and 5 population/intervention analyses. Results revealed that thoracic petechiae (80-90%), pulmonary congestion (~85%) and pulmonary oedema (~62%) dominate the autopsy picture [1,2], reflecting protracted hypoxia, negative intrathoracic swings and capillary leak. Newborns are obligate nasal breathers with small collapsible airways, compliant chest walls and an oxygen demand twice that of adults. PVC and polyurethane emit toluene, formaldehyde, chlorinated phosphates and phthalates, releasing up to 140 $\mu\text{g m}^{-2} \text{h}^{-1}$ TVOCs at 36°C [3, 6]. Vinyl covers quadruple CO₂ half-clearance versus wool; head-surface temperature rises 1.72-3°C [4,5]. Foam cores harbour *Trichosporon*, *Cladosporium* and *S. aureus*; fungi convert antimony (III) oxide to stibine gas, while *S. aureus* secretes α -toxin that blocks cardiac Na⁺ channels [7]. Hepatic antimony concentrations are two- to five-fold higher in SIDS cases than in explained deaths [13]. Cardiac conduction-system abnormalities appear in 40-54% of cases [11], and hippocampal maldevelopment in ~43% [12]. The pathophysiological cascade proceeds through chemical phase (VOCs/toxins inflaming airway mucosa and depressing chemoreception), ventilatory phase (CO₂ re-breathing causing hypercapnia progressing to central apnoea), and thermal phase (heat stress shifting

autonomic balance toward brady-arrhythmia while raising O₂ demand). This sequence recreates the autopsy triad and explains why removing or encapsulating plastic bedding abolishes deaths.

Summary and conclusions.

Neonatal anatomy, mattress microbiology and exposure physics converge: VOC off-gassing, CO₂ re-breathing and heat stress, each amplified by plastic, polyurethane foam and flame retardants, reproduce the canonical pathology of SIDS. Nations that eliminated or encapsulated these materials achieved the steepest, most durable mortality declines. The integrated pathophysiological model presented reconciles the previously unexplained autopsy triad (thoracic petechiae, pulmonary congestion/oedema, medullary gliosis) with measurable environmental exposures from plastic bedding materials. Aligning manufacturing standards, hospital procurement and public-health messaging with this evidence could replicate the success of Italy, Denmark, Slovenia and New Zealand worldwide, potentially eliminating the remaining ~3,500 annual SIDS deaths in developed nations.

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IMPLEMENTATION OF DIGITAL TECHNOLOGIES IN THE PROCESS OF ANTI-CRISIS MANAGEMENT BY AN INSURANCE COMPANY

ІМПЛЕМЕНТАЦІЯ ЦИФРОВИХ ТЕХНОЛОГІЙ У ПРОЦЕС АНТИКРИЗОВОГО УПРАВЛІННЯ СТРАХОВОЮ КОМПАНІЄЮ

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Анотація. Досліджено роль цифрових технологій у підвищенні ефективності антикризового управління страховими компаніями в умовах економічної та воєнної нестабільності. Обґрунтовано, що цифровізація страхового сектору є ключовим механізмом адаптації до зростання фінансових ризиків і невизначеності. Проаналізовано можливості застосування Big Data, штучного інтелекту, машинного навчання, роботизації бізнес-процесів і хмарних платформ у прогнозуванні ризиків, оптимізації страхових резервів і підтримці управлінських рішень. Доведено, що впровадження цифрових інструментів скорочує час реагування на кризові події, підвищує точність прогнозування збитків і сприяє зміцненню фінансової стійкості та конкурентоспроможності страховиків.

Ключові слова: антикризове управління, страхова компанія, цифровізація страхування, роботизація бізнес-процесів (RPA), хмарні технології, аналітичні платформи, прогнозування ризиків, страхові резерви, фінансова стійкість страховика.

Abstract. The role of digital technologies in increasing the effectiveness of anti-crisis management by insurance companies in conditions of economic and military instability is studied. It is substantiated that the digitalization of the insurance sector is a key mechanism for adapting to the growth of financial risks and uncertainty. The possibilities of using Big Data, artificial intelligence, machine learning, robotization of business processes and cloud platforms in risk forecasting, optimization of insurance reserves and support of management decisions are analyzed. It is proven that the implementation of digital tools reduces the response time to crisis events, increases the accuracy of loss forecasting and helps to strengthen the financial stability and competitiveness of insurers.

Key words: crisis management, insurance company, insurance digitalization, business process automation (RPA), cloud technologies, analytical platforms, risk forecasting, insurance reserves, financial stability of the insurer.

Вступ.

В умовах глобалізації, економічної нестабільності та зростання ризиків функціонування фінансових установ, страхові компанії стикаються з необхідністю підвищення ефективності антикризового управління. Цифрові технології відкривають нові можливості для прогнозування ризиків, оптимізації внутрішніх процесів та підвищення платоспроможності страховика.