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THE COMPOUNDING OF ALARMS: PSYCHOLOGICAL EFFECTS ON A MOTHER CARING FOR AN INFANT WITH A GLUCOSE MONITOR DURING WARTIME: A REVIEW AND CONCEPTUAL ANALYSIS

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Abstract

Caregivers of infants with continuous glucose monitors (CGMs) already carry a well-documented psychological burden, driven in large part by loud, unpredictable device alarms that signal hypoglycemic danger. When this burden is layered onto a wartime environment in which air-raid sirens are a recurring feature of daily life, the caregiver is exposed to two structurally similar but functionally distinct alarm systems that compete for the same threat-detection circuitry in the brain. This paper reviews the literature on CGM-related caregiver anxiety and on the psychological effects of war sirens on mothers, and integrates it with research on fear-potentiated startle and auditory trauma sensitization to propose a conceptual model of "compounded alarm exposure." It argues that the co-occurrence of a medical alarm and a war alarm does not simply add two independent stressors but may amplify each through shared neurobiological pathways, producing heightened hypervigilance, sleep disruption, and anticipatory dread. The paper closes with recommendations for device design, clinical screening, and psychosocial support for mothers in conflict settings.

Keywords: ontinuous glucose monitoring (CGM), infant caregivers, maternal anxiety, caregiver burden; alarm fatigue; war-related stress

Introduction

Raising an infant with a chronic medical condition is demanding under ordinary circumstances. When that infant depends on a continuous glucose monitor (CGM) that emits a loud alert whenever blood sugar drops below a set threshold, caregivers—most often mothers—must live in a state of ongoing readiness, prepared to respond to a sound that signals potential danger to their child at any hour of the day or night. This paper considers a specific and increasingly relevant case: a mother whose infant wears a CGM with a piercing low-glucose alarm, living in a country where air-raid or war sirens are also part of daily life. The two sounds differ in origin and meaning, yet both are loud, sudden, and tied to the possibility of harm to a loved one. The central question addressed here is how the psychological effects of a medical alarm and a war alarm interact when a single caregiver is exposed to both, and what that interaction implies for maternal mental health.

The paper proceeds in five parts. First, it reviews what is known about the psychological burden of CGM

alarms on parents and caregivers. Second, it reviews research on the effects of war sirens on maternal and child mental health. Third, it draws on the neuroscience of the acoustic startle reflex and fear conditioning to explain why two unrelated alarm systems might compound one another rather than simply add up. Fourth, it discusses the specific psychological effects likely to emerge in a mother facing both alarm systems simultaneously. Fifth, it considers implications for clinical practice, device design, and support for mothers raising medically fragile children in conflict zones.

2. The Psychological Burden of Glucose Monitor Alarms

Continuous glucose monitors were developed to reduce the danger of undetected hypoglycemia by alerting caregivers in real time, and there is evidence that they can ease some aspects of caregiving, including improving sleep for some families and easing school-related worry. At the same time, a substantial body of research shows that CGM alarms themselves are a source of psychological strain. Caregivers of young children with type 1 diabetes describe a state of near-constant vigilance that intensifies once an alarm-based device enters the home, because every alert must be interpreted and acted on, and the possibility of a night-time low prompts frequent awakenings even when no alarm has sounded.

Comparative work on caregiver psychosocial outcomes finds that CGM use is associated with mixed effects depending on who is reporting: adults using CGM for themselves tend to report less anxiety than those using older blood-glucose testing methods, but parents of children on CGM report more depressive symptoms than parents relying on manual testing, and caregiver burden is significantly higher among parents of CGM-using children than among CGM-using adults themselves. A systematic review of psychological outcomes in pediatric CGM users identifies alarm fatigue as a recurrent theme alongside diabetes distress, impaired sleep, and fear of hypoglycemia, and notes that fear of hypoglycemia often persists even when glucose levels are objectively stable, because the fear becomes attached to the possibility of a future alarm rather than to any single event. Qualitative interviews with parents further show that trust in the technology is fragile: sensor errors, false alarms, and technical failures are themselves a source of distress, since a malfunctioning alarm undermines the caregiver's ability to distinguish a genuine emergency from a device error, which can heighten rather than reduce anxiety over time.

Mothers in particular appear to carry a disproportionate share of this burden. Research on caregiving in pediatric type 1 diabetes consistently finds that mothers report more severe distress symptoms than fathers, likely reflecting that mothers are more often the primary, round-the-clock responder to device alerts, including through the night. For a mother of an infant, who cannot describe her own symptoms and depends entirely on the caregiver's vigilance, this burden is amplified further: there is no verbal feedback from the child to reassure the mother between alarms, so the alarm itself becomes the primary channel through which she monitors her infant's safety.

3. War Sirens and Maternal Mental Health

A parallel literature has emerged on the psychological toll of living under recurrent air-raid sirens. Studies conducted during recent conflicts show that maternal anxiety rises sharply during periods of sustained missile and rocket threat, and that this anxiety is closely linked to children's own emotional distress, with mothers who feel less able to manage the danger, and who avoid discussing it with their children, reporting the poorest outcomes for both themselves and their children. Field reports from Ukraine describe families who have spent thousands of cumulative hours under air-raid alerts over several years, with parents describing constant emotional strain, disrupted sleep, and a nervous system that never fully stands down even between alarms. Children exposed to repeated sirens have been found to become anxious and hyper-

reactive to loud noise generally, not only to the siren itself, suggesting that the alarm's threat association can generalize outward to ordinary sounds.

Historical research on populations that lived through sustained bombing campaigns similarly found that most people adapted with resilience, but that a meaningful subgroup exposed to substantial danger developed lasting psychological difficulty, with mothers bearing additional strain tied to evacuation, disruption of routine, and the burden of protecting children while managing their own fear. More recent occupational-therapy research on children who lived through sudden, intense periods of siren exposure has found that the brain's threat-detection system can become sensitized well after the acute danger has passed, losing the ability to distinguish an ordinary loud noise from a genuine threat signal, with this heightened sensitivity persisting for many months without targeted intervention. Taken together, this literature indicates that repeated siren exposure produces effects extending beyond the moments of actual danger: a generalized hyperarousal that colors the caregiver's relationship to sound itself.

4. Why Two Alarms May Compound Rather Than Simply Add

Neuroscience research on the acoustic startle reflex offers a plausible mechanism for why a medical alarm and a war siren might interact rather than operate as two separate, additive stressors. The startle reflex is a rapid, largely automatic response to a sudden loud sound, mediated by brainstem circuitry but modulated by the amygdala once a sound has been linked to danger through experience. This modulation is known as fear-potentiated startle: after a sound has been associated with threat, later exposure to a similar sound produces an exaggerated startle response, even in contexts where the original danger is absent. Laboratory studies further show that repeated elicitation of the startle reflex can itself produce sensitization, meaning startle responses can grow stronger with repeated exposure rather than habituate, particularly for abrupt, sharp-onset sounds of the kind produced by both sirens and medical alarms.

Applied to a mother whose infant wears a CGM in a country under wartime alert, this research suggests several plausible pathways of compounding. First, both the war siren and the CGM alarm are sudden, high-salience sounds tied to the safety of loved ones, so each can prime the nervous system's general threat-detection response, making a subsequent alarm of either kind harder to ignore and more likely to trigger a full stress response. Second, because a mother in this position cannot predict which alarm will sound next, she may be pushed into a state of continuous auditory monitoring, unable to fully stand down between alerts of either type, mirroring the sustained hyperarousal documented among caregivers exposed to prolonged siren activity. Third, the emotional association built around the war siren, which signals danger to the whole family, may generalize to the CGM alarm even though the two devices are functionally unrelated, so that hearing the medical alarm can evoke a fear response disproportionate to the immediate medical situation, and vice versa. This generalization is consistent with findings that survivors of repeated siren exposure lose the ability to reliably distinguish a threatening sound from an ordinary one.

A further consideration is timing and unpredictability. Both alarms tend to be intermittent and unscheduled, and stress research generally identifies unpredictable stressors as more taxing than continuous or foreseeable ones, because the nervous system cannot down-regulate in anticipation of safe periods. A mother facing two independent sources of unpredictable alarm has, in effect, two separate triggers competing to interrupt any period of calm, which may shorten recovery time between stress episodes and contribute to cumulative physiological strain over weeks and months.

5. Psychological Effects on the Mother

Drawing together the two literatures reviewed above, several specific psychological effects can be

anticipated for a mother in this dual-alarm situation. The first is heightened and prolonged hypervigilance: rather than being on guard only during moments of actual medical risk or actual military danger, she may find herself continuously scanning her auditory environment, unable to relax fully even during quiet periods, because either alarm could sound at any time. The second is sleep disruption compounding sleep disruption, since both CGM alerts and night-time siren activity are known independently to interrupt sleep, and their combination is likely to produce more fragmented and less restorative rest than either would alone.

A third effect is anticipatory anxiety, sometimes described in the diabetes literature as fear of hypoglycemia even in the absence of a current low reading. In a wartime context this fear of a future alarm may extend beyond the medical device to encompass a broader fear of the next siren, creating a generalized sense of dread that is not tied to any single, resolvable threat. A fourth effect is emotional exhaustion and reduced capacity for warm, responsive caregiving, a pattern documented among mothers raising children under sustained war conditions, in which the demands of constant threat monitoring can leave less emotional bandwidth for other aspects of parenting, not because of any deficiency in the mother but because of the sheer physiological cost of sustained alertness. Finally, there is a risk that the two alarms become linked to one another in the mother's mind, so that in time either sound, or even sounds that merely resemble them, can trigger the full fear response associated with both, a pattern consistent with the generalization of conditioned fear documented in trauma research.

It is worth noting that these effects need not indicate a diagnosable disorder to be significant. Much of the caregiver-burden literature on CGM use, and much of the maternal-anxiety literature on war exposure, describes clinically meaningful distress that falls short of a formal diagnosis such as post-traumatic stress disorder, yet still substantially affects daily functioning, sleep, and quality of life. A mother in the situation described here may never meet full diagnostic criteria for an anxiety or trauma-related disorder while nonetheless experiencing a level of chronic strain that warrants clinical attention and practical support.

6. Implications and Recommendations

Several practical implications follow from this analysis. Clinically, providers who prescribe CGMs for infants in conflict-affected regions should be aware that standard alarm thresholds and alert tones, calibrated for ordinary civilian settings, may interact poorly with an already siren-saturated auditory environment, and should discuss with caregivers whether alert sounds, vibration options, or smartphone-based silent alerts can be adjusted to reduce unnecessary overlap with wartime cues. Diabetes care teams are well positioned to screen for caregiver alarm fatigue and diabetes distress at routine visits, and in conflict settings this screening should explicitly ask about the co-occurrence of medical and military alarms rather than treating them as unrelated topics.

From a device-design perspective, manufacturers could consider offering alert tones that are acoustically distinct from common regional air-raid signals, along with customizable alarm escalation patterns that allow a caregiver to reduce alarm sensitivity during periods of known heightened stress without compromising infant safety. From a psychosocial-support perspective, the literature on maternal self-efficacy and parent-child communication during wartime suggests that interventions strengthening a mother's confidence in her ability to manage danger, together with structured opportunities for mothers to process both the medical and military dimensions of their stress, may buffer against the worst effects of compounded alarm exposure. Community and humanitarian organizations working with families of medically fragile children in conflict zones should consider integrating psychological first aid and caregiver respite specifically for this population, recognizing that they face a distinctive and underrecognized combination of chronic medical vigilance and acute security threat.

7. Conclusion

A mother caring for an infant with a glucose-monitoring alarm in a country under wartime siren alert occupies a psychologically distinctive position. Neither literature reviewed here, on CGM caregiver burden or on war-siren exposure, was developed with this combination in mind, yet each identifies mechanisms, from fear-potentiated startle to generalized hyperarousal, that plausibly interact when the two alarm systems coexist in a single caregiver's life. Recognizing this compounding is a necessary first step toward better clinical screening, more thoughtful device design, and more targeted psychosocial support for mothers navigating both chronic medical vigilance and the acute, unpredictable danger of war

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