Immortalitas in Vita Hac
Longevity Platform
https://www.longevity.ge
Longevity Horizon
ISSN: 3088-4063
2025
Vol.1 No.4:3

Concept of Death Awareness as an Existential Regulator in the Age of Biological Immortality

Jaba Tkemaladze
E-mail: jtkemaladze@longevity.ge
Citation: Tkemaladze, J. (2025). Concept of Death Awareness as an Existential Regulator in the Age of Biological Immortality. Longevity Horizon, 1(4). doi : https://doi.org/10.5281/zenodo.17340207

Abstract

The rapid advancement of biogerontology, particularly through interventions like senolytic therapies and stem cell rejuvenation, is transforming the prospect of radical life extension and even biological immortality from science fiction into a plausible future scenario. This impending paradigm shift necessitates a profound re-examination of existential psychology, which has traditionally posited awareness of mortality as the fundamental source of life's meaning, motivation, and authenticity. This article argues that the psychological phenomenon of death awareness would not simply vanish with the elimination of biological finitude. Instead, it would undergo a critical functional transformation. It proposes the concept of an "existential alarm clock," a reconstituted internal mechanism that shifts from serving as a chronological limit to acting as a qualitative regulator of existence. In a state of immortality, this alarm would awaken the individual from the unique perils of an endless lifespan: existential apathy, identity stagnation, and the "bad infinity" of undifferentiated time. The article analyzes the mechanisms of this alarm—triggering identity crises, combating profound boredom, and stimulating self-transcendence—and explores its vast social, cultural, and ethical implications. It concludes that, paradoxically, a continued dialogue with the concept of death remains a crucial condition for a meaningful and authentic life, even in the context of biological immortality.

Keywords: Thanatology, Existential Psychology, Biological Immortality, Senescence, Meaning of Life, Mortality Salience, Terror Management Theory, Identity Crisis, Self-Transcendence.

Introduction

The human condition has, for millennia, been fundamentally framed by its finitude. The inescapable reality of death has served as the ultimate horizon against which questions of meaning, value, and authenticity are projected. However, the nascent field of biogerontology is progressively challenging this most basic of biological imperatives. A confluence of advanced research trajectories is rendering the hypothetical achievement of radical life extension—or even biological immortality—an increasingly plausible scenario, moving it from the realm of science fiction into a tangible subject for scientific and philosophical inquiry.

The scientific foundation for this paradigm shift is being laid in laboratories worldwide. Cutting-edge interventions are targeting the very mechanisms of aging. For instance, research into in vitro gametogenesis and the derivation of safe, adult, rapidly-dividing young stem cells points to a future where a person's own aged, quiescent stem cell population could be replenished (Hayashi et al., 2011; Saitou & Miyauchi, 2016). The transplantation of such youthful, potent stem cells into an aging organism is hypothesized to not only replace senescent and old, slowly-dividing cells but also to increase the overall rate of tissue regeneration, effectively rejuvenating the organism (López-Otín et al., 2013; de Haan et al., 2018). Furthermore, targeted senolytics—therapies designed to clear the body of senescent "zombie" cells that contribute to inflammation and aging—are showing remarkable efficacy in preclinical models, restoring function and extending healthspan (Kirkland & Tchkonia, 2020; Xu et al., 2018). The synergistic application of these approaches—clearing the old and introducing the new—suggests a future where the degenerative process of aging could be halted or even reversed.

This impending biological revolution necessitates a profound and parallel examination of its psychological and existential consequences. For traditional existential philosophy and psychology, the awareness of mortality is not merely a morbid fact but the very cornerstone of a meaningful life. Heidegger (1927/1962) posited that authentic existence is only possible through a resolute "being-toward-death" (Sein-zum-Tode), where the individual, confronted with their own finitude, is jolted out of the impersonal "they" (das Man) and into taking responsibility for their unique potential. Similarly, thinkers like Jaspers and Buber emphasized that confronting our "limit-situations" (Grenzsituationen), with death being the ultimate one, is what gives depth and gravity to human existence and relation. In psychology, this notion is powerfully echoed in the works of Viktor Frankl (1946/1985), who found that the "will to meaning" is the primary motivational force in humans, a force often sharpened by the reality of suffering and death. Irvin Yalom (1980) explicitly identified death awareness as a primary source of existential anxiety and, paradoxically, a crucial "awakening" experience that can propel individuals toward significant life changes, infusing their actions with urgency and purpose. The central, unsettling question thus arises: What becomes of the human psyche, culture, and the very experience of meaning if this foundational cornerstone—our finitude—is technologically removed?

The prevailing concern is that the removal of death's chronological limit would lead to an existential catastrophe: a state of profound apathy, infinite procrastination, and a devaluation of all experience, a concept often termed "the tedium of immortality" (Williams, 1973). If one has an unlimited amount of time, the urgency to act, to love, to create, and to choose dissipates. The "someday" becomes a perpetual, paralyzing promise.

This article proposes a counter-hypothesis. It argues that in the context of biological immortality, the psychological phenomenon of death awareness does not simply vanish but undergoes a critical transformation. It ceases to function primarily as a chronological limit and is reconstituted as an "existential alarm clock." This internal mechanism would no longer signal the impending end of biological time but would instead serve to awaken the individual from states of existential slumber, spiritual stagnation, and the psychological torpor induced by the prospect of unlimited time. Rather than reminding us that we will die, this transformed awareness would remind us whether we are truly living. It would become a catalyst for qualitative, rather than quantitative, existence, prompting continuous self-assessment, re-invention, and the pursuit of authentic engagement with the world, even in the face of eternity.

Analysis of Key Concepts

To fully grasp the implications of a post-mortality future, it is essential to first deconstruct the two central, and seemingly opposing, concepts at play: the existential function of death awareness and the practical definition of the hypothetical biological immortality that may one day supplant it.

Death Awareness in the Existential Paradigm

Within existential thought, the awareness of mortality is not a mere biological endpoint but a constitutive force that shapes human psychology and culture. Its role is multifaceted, serving as a structuring principle for an authentic life, a psychological catalyst for change, and the fundamental driver of cultural achievement.

First, from a philosophical standpoint, Martin Heidegger's concept of "being-toward-death" (Sein-zum-Tode) is paramount. For Heidegger, an authentic existence requires a resolute "running-forward" (Vorlaufen) into the possibility of one's own death. This is not a morbid obsession but a profound acknowledgment of one's own finitude as life's ultimate certainty. By confronting this "possibility of the absolute impossibility of [our] existence," the individual is jolted out of the impersonal, everyday conformity of the "they" (das Man) (Heidegger, 1927/1996). This confrontation individuates us, forcing us to take ownership of our lives as a finite project. It is this very finitude that grants life its coherence and urgency; our choices matter precisely because our time is limited. The awareness of death, therefore, is the ground upon which a life of authenticity and integrity is built, compelling us to live in a way that is truly our own.

Building upon this philosophical foundation, existential psychology has empirically demonstrated the functional utility of death awareness. Irvin Yalom (1980) systematically identified death as a primary source of existential anxiety, but more importantly, he illustrated how confrontation with

this anxiety can serve as a vital psychological resource. A diagnosis of a terminal illness, a near-death experience, or even the profound realization of mortality can trigger a powerful "awakening" experience. This awakening often manifests as a seismic shift in life priorities, a sharpened sensory perception where life feels more vivid, and a heightened sense of personal responsibility (Mogilner et al., 2018; Lykins et al., 2007). Studies in terror management theory (TMT), which is directly inspired by existential thought, provide robust experimental evidence that mortality salience—the conscious or subconscious awareness of death—profoundly influences human behavior, from reinforcing cultural worldviews to motivating achievements and prosocial acts (Greenberg et al., 2014; Pyszczynski et al., 2015). The confrontation with death, therefore, acts as a psychological imperative that pulls individuals out of complacency and toward a more engaged and meaningful mode of being.

Finally, on a cultural level, anthropologist Ernest Becker synthesized these ideas in his Pulitzer Prize-winning work, arguing that the terror of death is the primary engine of human civilization. In The Denial of Death (1973), Becker posits that the entirety of human culture—our religions, art, political systems, and scientific pursuits—constitutes a "symbolic system of death denial." This "heroic project" is a collective, symbolic defense mechanism against the paralyzing awareness of our own insignificance and decay. By creating and investing in enduring cultural structures and values, we achieve a kind of symbolic immortality, convincing ourselves that we are part of something larger and more permanent than our fragile physical selves (Solomon et al., 2015). Thus, culture itself can be interpreted as a monumental, collective response to the existential problem of death, a project driven by the need to transcend our biological fate.

Hypothetical Biological Immortality

In contrast to the existential weight of mortality, the concept of biological immortality discussed here must be precisely defined. It is crucial to clarify that this does not mean invulnerability or the cessation of all possible causes of death. Accidents, trauma, homicide, or suicide would remain statistical possibilities (Maier, 2019). Rather, biological immortality refers specifically to the elimination of senescence—the biological process of aging. This would entail the successful neutralization of the hallmarks of aging, such as genomic instability, telomere attrition, and cellular senescence, thereby abolishing death from natural causes like cancer, cardiovascular disease, and neurodegenerative disorders (López-Otín et al., 2013).

The scientific pursuit of this goal is accelerating. Research is increasingly focused on interventions that target aging at the systemic level. For instance, the development of senolytic drugs—compounds that selectively clear senescent "zombie" cells that accumulate with age and drive inflammation and dysfunction—has shown remarkable potential in preclinical models to extend healthspan and lifespan (Kirkland & Tchkonia, 2020; Xu et al., 2018). Similarly, strategies involving the transplantation of young, healthy stem cells to rejuvenate aged tissues and restore regenerative capacity are moving from theory to experimental practice, offering a pathway to reverse, not just slow, the aging process (de Haan et al., 2018; Yousefzadeh et al., 2018). These approaches, among others, form the tangible basis for the hypothetical scenario under consideration.

This leads to the central paradox that this article seeks to address: the elimination of death as a biological fact does not annul the existential questions of meaning, identity, and value that have always been intertwined with it. On the contrary, it may exacerbate them to an unprecedented degree. If the traditional "solutions" to existential anxiety—the heroic projects of culture and the urgency derived from finitude—are rendered obsolete or profoundly altered by the conquest of aging, the human psyche will be forced to confront these questions on new, uncharted terrain. The problem of meaning would no longer be framed by the limit of time, but by its potentially limitless abundance, creating a novel and formidable existential challenge.

The Concept of the "Existential Alarm Clock"

Given the profound role death awareness plays in structuring human psychology and the paradoxical existential vacuum its biological elimination might create, a new framework is necessary. This article proposes that death awareness would not vanish but would undergo a fundamental functional shift. It would cease to operate as a chronological limiter—the external deadline that gives time its shape and value—and would be reconstituted as an "existential alarm clock." This internal mechanism would function not to signal the end of time, but to catalyze the quality of being within time. Its purpose would be to awaken the individual from the unique forms of psychological stagnation induced by a potentially endless lifespan.

The Shift in Function: From Quantity to Quality

The primary function of the existential alarm clock is to transition the psychological impact of mortality from a quantitative to a qualitative register. Where traditional death awareness imposes a limit on the amount of life, the alarm clock would enforce a standard for the experience of it. Neuropsychological research suggests that the perception of time and the value assigned to experiences are deeply linked to our goal-directed behaviors and neural reward systems (Shimp et al., 2015; van der Meer et al., 2012). The removal of a definitive endpoint could pathologically dampen this system, leading to a devaluation of goal-seeking. The existential alarm clock would counteract this by generating a subjective sense of urgency rooted not in scarcity of time, but in the poverty of experience. It would become a cognitive-affective tool for self-regulation, prompting course-correction when life, though long, becomes shallow, repetitive, or inauthentic.

The Mechanism of the Alarm Clock

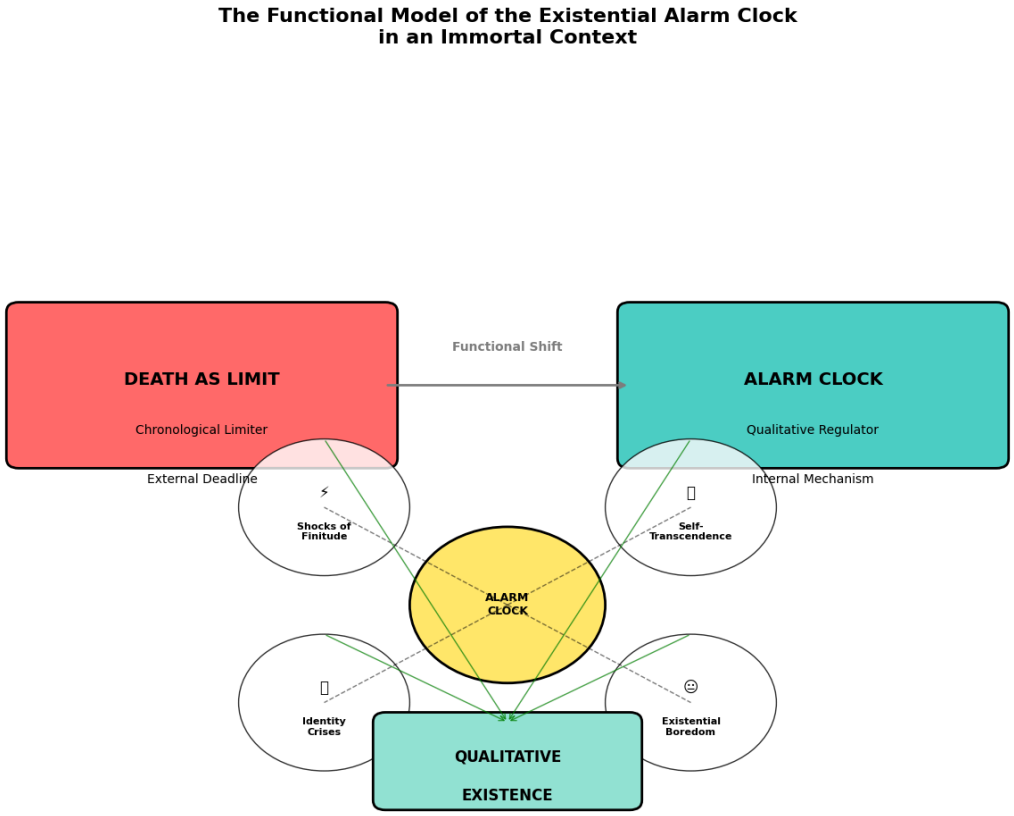
The alarm clock would manifest through several distinct, yet interrelated, psychological phenomena.

In an immortal existence, the individual risks becoming trapped in a single, static identity. A professional role, a set of relationships, or a worldview adopted in one century may become a psychic prison over several. The existential alarm clock would sound through intense crises of identity, which would function as signals of the "death" of an outmoded self. The profound distress associated with such crises—feelings of meaninglessness, alienation, and a loss of purpose—would be the alarm's ringtone (Kroger & Marcia, 2011). This is not a pathology to be avoided, but a necessary catalyst for what could be termed "serial selves" or "volitional

re-identification." The individual is pushed to shed an old identity and embark on the process of constructing a new one, a form of psychological rebirth essential for navigating an indefinitely long life (Sneed & Whitbourne, 2005). The alarm reminds one that while the body may persist, a self that does not evolve is, in a meaningful sense, already dead.

A primary psychological threat of immortality is profound existential boredom (Langweile)—a pervasive sense of emptiness and disinterest that arises from the perception that all possibilities are perpetually available (Svendsen, 2005). The phrase "I can always do it later" becomes a paralyzing mantra, leading to a state of aboulia, or a severe loss of will (Schnapp & Fernandez, 2018). The existential alarm clock would trigger in moments of deep, non-situational apathy, experienced not as simple laziness but as a crushing weight of insignificance. This feeling would serve as a critical signal, mirroring the "awakening" experience described by Yalom (1980) in terminal patients. It would be a jarring reminder not of life's impending end, but of its current unlived quality. The alarm would provoke the question: "If I have all the time in the world, why does none of it feel valuable?" This discomfort would be the necessary impetus to seek out new challenges, commit to demanding projects, and re-engage with the world, thereby restoring subjective value to time.

Figure 1: The Functional Model of the Existential Alarm Clock in an Immortal Context. A conceptual diagram showing the shift from Death as a Limit to the Alarm Clock as a Regulator, with feedback loops illustrating the four key manifestations: Identity Crises, Existential Boredom, Shocks of Finitude, and the Drive for Self-Transcendence, all contributing to the outcome of "Qualitative Existence."



The reconstitution of death awareness into an existential alarm clock. The mechanism creates a feedback loop where psychological distress signals (the "alarm") prompt course-correction towards a more engaged and meaningful existence.

An immortal life could easily devolve into what Hegel termed a "bad infinity"—a monotonous, homogeneous succession of days without climax or resolution. The existential alarm clock would leverage residual finitude to break this cycle. Shocking events, such as the death of mortal loved ones or witnessing large-scale planetary crises, would take on a new symbolic function (O'Connell et al., 2021). For the immortal individual, these events would not be reminders of their own inevitable fate, but rather powerful, affective reminders of the fragility of connections and the irreplaceable uniqueness of each moment within the eternal flow. The grief and shock would serve as the alarm, jolting the individual out of complacency and highlighting the precious, non-renewable nature of specific relationships and experiences, even against the backdrop of personal eternity. It would reinforce that meaning is often found in temporary, not permanent, things.

Ultimately, the most critical function of the existential alarm clock would be to propel the individual toward self-transcendence. Drawing from Viktor Frankl's logotherapy, the ultimate source of meaning is found not within oneself but in reaching out toward something or someone beyond oneself—be it a creative work, a cause, or another person (Frankl, 1959). In an immortal existence, the primary existential danger becomes a pathological self-absorption and a hedonic treadmill focused solely on self-preservation and pleasure. The alarm would sound as a deep sense of existential guilt or emptiness arising from a life lived purely for oneself (Längle, 2016). This feeling would be the catalyst to dedicate one's vast resources of time and experience to a larger purpose: the pursuit of profound artistic or scientific creation, the altruistic aid of others, or the grand project of cosmic exploration. The alarm reminds the immortal being that a life of mere self-perpetuation is not a life at all; true fulfillment begins where the self ends.

Social and Cultural Consequences

The internal psychological reconstitution of death awareness into an "existential alarm clock" would inevitably precipitate profound and far-reaching changes across all levels of human society. The institutions, cultural narratives, and ethical frameworks that have evolved within the paradigm of finitude would be forced to adapt to a new reality defined by radical life extension. These transformations would be as significant as the psychological shift itself, reshaping the very fabric of human civilization.

Transformation of Social Institutions

The most immediate and practical changes would occur within core social institutions, which would need to be re-engineered for a lifespan of indefinite duration.

The education system, for instance, is currently structured around a "front-loaded" model—intensive learning in youth to prepare for a finite working life (Fischer et al., 2020). This model would become obsolete. In its place, a system of continuous, cyclical education would

emerge, aligned with the concept of "serial selves." Individuals would periodically return to formal and informal learning environments to facilitate radical career shifts and identity transformations (Kegan, 2018). Neuroscientific research on neuroplasticity across the lifespan confirms that the adult brain remains highly adaptable, capable of learning new skills and knowledge well into advanced age (Zuo et al., 2019). In an immortal society, education would become a lifelong tool for intentional self-reinvention, a structured response to the "alarm" of professional or personal stagnation.

Concurrently, the fields of psychology and philosophy would transition from peripheral support services to central, essential practices. The management of the "existential alarm clock" would become a primary mental health concern. Therapeutic modalities would need to evolve beyond treating pathology rooted in a finite lifespan and develop new frameworks for addressing immortality-specific crises: the "tyranny of choice" in an open-ended life, the grief of losing mortal loved ones, and the profound weight of eternal responsibility (Kessler, 2019). Logotherapy, existential analysis, and narrative therapy would likely form the cornerstone of a new "geronto-existential" psychology focused on meaning-making, identity navigation, and fostering resilience against existential boredom (Vos, 2018). The philosopher, too, would play a more practical role, guiding individuals and communities in the ongoing project of constructing a meaningful life in the absence of death's defining limit.

New Forms of Art and Narrative

Human culture, which Ernest Becker argued is a "heroic project" of death denial, would undergo a fundamental creative revolution. The central conflict that has driven Western narrative art for millennia—"human vs. death"—would lose its visceral power. The tragic hero fighting against their inevitable demise would become a historical archetype, much like the mythological hero battling gods is today.

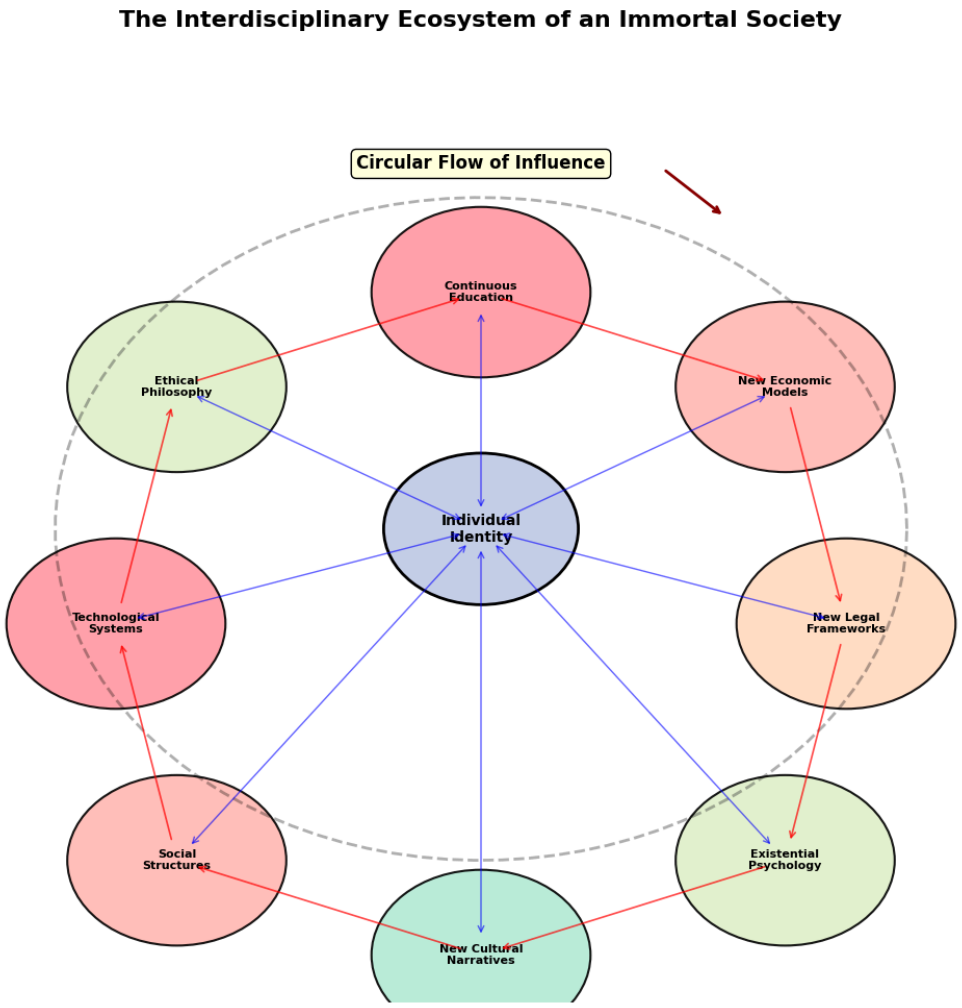
In its place, new genres of tragedy and drama would arise, centered on the unique dilemmas of immortality. Narratives would explore the tragedy of perpetual choice, where every path taken represents an infinite number of paths forsaken, leading to a unique form of regret (Schwartz, 2004). The drama of identity erosion would become a central theme, exploring the psychological toll of shedding multiple selves over centuries and the struggle to maintain a coherent sense of continuity (Sneed & Whitbourne, 2005). Art would grapple with the burden of memory, the agony of watching history repeat its mistakes, and the profound loneliness of outliving cultures, languages, and planets. These new narratives would not just entertain; they would serve as cultural instruments for collectively processing and understanding the new human condition, providing a mirror for the internal workings of the existential alarm clock.

Ethics, Law, and Policy

The legal and ethical landscape would face unprecedented challenges, demanding a radical rethinking of fundamental rights and social contracts.

The most poignant ethical question would be the right to a self-determined death. If aging is conquered, the ability to end one's life would become the ultimate expression of autonomy—the final "snooze" button on the existential alarm clock that one could choose never to press again. The debate around physician-assisted dying would intensify, evolving into a discussion about the right to "completion" after a full and potentially endless life (Young & Earp, 2020). This would necessitate robust legal and psychological frameworks to distinguish a rational, sustained desire for completion from a treatable, transient existential crisis.

Figure 2: The Interdisciplinary Ecosystem of an Immortal Society. A circular diagram showing the interconnectedness of transformed fields: Continuous Education feeding into New Economic Models, which are regulated by New Legal Frameworks, which are informed by Existential Psychology and Philosophy, which inspire New Cultural Narratives, which in turn influence individual identity and feed back into the education system.



The societal transformations necessitated by biological immortality create an interconnected ecosystem where changes in one domain directly influence others, all centered on the psychological challenge of managing perpetual existence.

Furthermore, the demographic reality of biological immortality would force a global reckoning with population dynamics. The continuous accumulation of immortal individuals would render

current population models unsustainable, leading to stringent and ethically fraught policies on reproduction regulation (Maier, 2019). Societies would face difficult choices between enforcing a "one-child" policy or similar strict measures and confronting a Malthusian catastrophe of resource depletion. This would raise profound questions about intergenerational justice, the right to procreate, and the very definition of a sustainable society. The concept of "replacement" would become obsolete, forcing a shift in economic, urban, and environmental planning from models of renewal to models of perpetual maintenance for a static or slowly growing population.

Objections and Limitations to the Concept

While the model of the "existential alarm clock" provides a framework for understanding potential psychological adaptation to immortality, it is not without its plausible counterarguments and limitations. A rigorous examination must acknowledge and engage with significant challenges to the theory's validity and scope. These objections primarily question the motivational potency of a metaphorical alarm, the adaptive resilience of the human psyche, and the model's applicability to different forms of immortality.

The Argument of Diminished Salience

A primary and potent objection is that the removal of death's objective, final threat would strip the reconstituted awareness of its motivational power. The existential alarm clock, without the real and irreversible consequence of biological termination, may ring with a muffled and ultimately ignorable tone. The profound anxiety that Heidegger and Yalom identified as the catalyst for authenticity is rooted in the non-negotiable reality of non-being. If this reality is abolished, the ensuing "alarm" could devolve into a mere abstract concept, lacking the affective charge necessary to provoke genuine transformation (Kesebir & Pyszczynski, 2012).

Proponents of this view might argue that the human brain is exquisitely tuned to respond to concrete threats. Neurocognitive research shows that the neural systems processing immediate, tangible threats (e.g., the amygdala, insula) are distinct from those engaged in abstract, future-oriented thought (e.g., the prefrontal cortex) (LeDoux & Pine, 2016). The constant, low-grade signal of a metaphorical "stagnation" may fail to activate the same potent threat-response systems as the primal fear of death. Consequently, the individual could learn to cognitively override or habitually "snooze" the alarm, leading to a state of quietistic resignation rather than awakened engagement. The very concept of an "alarm" implies a state of emergency, which may be unsustainable in a context of ultimate biological safety.

Adaptive Hedonism and the Suppression of Existential Drives

A second major challenge is the potential for the human psyche to adapt to immortality not through meaning-seeking, but through a sophisticated and sustained adaptive hedonism. This objection posits that individuals could circumvent existential anxieties entirely by structuring an immortal life around the perpetual pursuit of novel pleasures and the avoidance of discomfort.

The brain's reward system, centered on dopaminergic pathways, is inherently geared toward seeking rewards and novelty (Berridge & Kringelbach, 2015). In an endless lifespan, one could

envision a future where advanced neurotechnologies, virtual realities, and pharmacological agents are used to create a continuous, curated stream of positive experiences (Savulescu & Persson, 2012). In such a scenario, the "existential alarm clock" might not ring at all, as the individual would be in a constant state of stimulated contentment, effectively anesthetized against any feelings of stagnation or meaninglessness. The capacity for humans to lose themselves in distraction and pleasure-seeking as a buffer against existential concerns is well-documented even within mortal lives (Kashdan & Breen, 2007); this tendency could become the dominant mode of existence in a context where such distractions are limitless and infinitely customizable. The alarm model presupposes a continued engagement with existential questions, but a hedonistic adaptation would represent a successful, if perhaps shallow, evasion of them.

Collective vs. Individual Immortality

A critical limitation of the proposed concept lies in its focus on individual biological immortality. The model's dynamics would shift fundamentally if the conquest of death occurred not at the individual level, but at the collective or species level, achieved through the indefinite continuation of the human lineage via successive generations.

In this scenario, the existential problem of the individual is not solved but is instead passed on. Each generation, while knowing the species may continue, still faces the personal reality of senescence and death. The "existential alarm clock" for a mortal individual within an immortal species would remain firmly rooted in their own personal finitude. The cultural and psychological consequences would be profoundly different. The urgency to contribute to a legacy, to pass knowledge to the next generation, and to find meaning within a single lifetime would persist with undiminished force (Wade-Benzoni & Tost, 2009). Furthermore, the social and ethical dilemmas would revolve around intergenerational equity and resource allocation between a dying older generation and an emerging new one, rather than the problems of perpetual identity and boredom among a cohort of eternally young individuals. The proposed model of the existential alarm clock, which is predicated on the removal of individual death, is therefore not directly applicable to a scenario of mere species longevity.

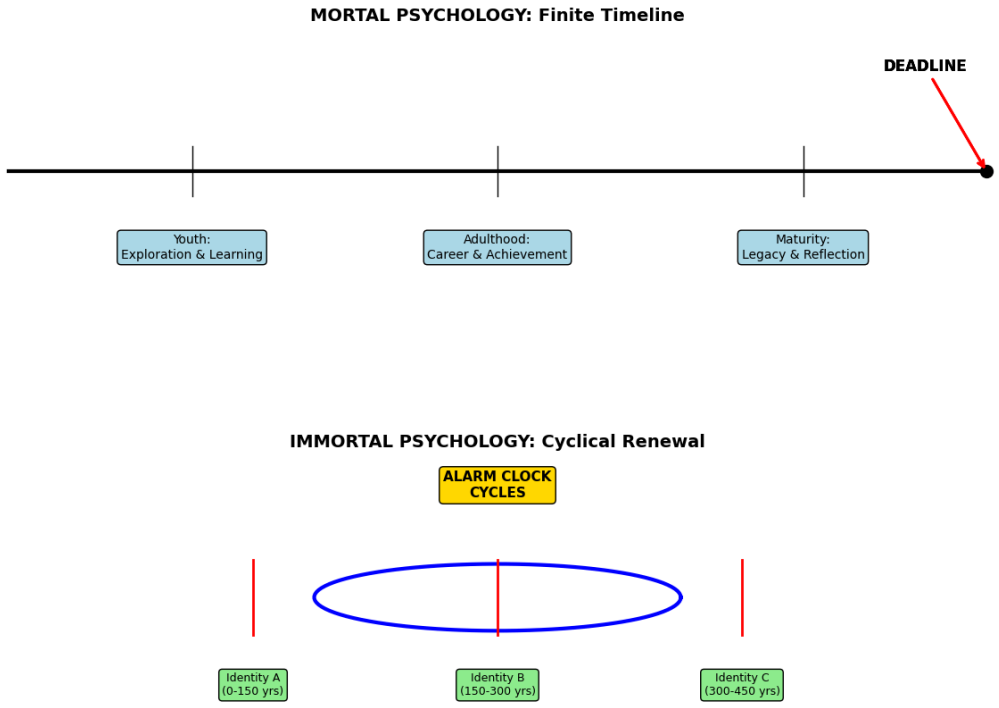
In conclusion, while the "existential alarm clock" offers a compelling framework, its viability is contested by the potential for its signal to be weakened without a real biological stakes, its function to be bypassed by hedonic adaptation, and its scope to be limited to a specific, individualistic form of immortality. These objections do not invalidate the model but highlight the profound uncertainty and complexity of projecting human psychology into a post-mortal future, underscoring the need for further interdisciplinary inquiry.

Conclusion and Findings

This examination began with a profound paradox: the potential technological achievement of biological immortality, which seeks to eliminate humanity's oldest and most certain fate, may simultaneously threaten to dismantle a fundamental pillar of psychological existence as we know it. The analysis conducted herein leads to several definitive conclusions regarding the

intricate relationship between death awareness and a meaningful life, even in a future where death is no longer biologically inevitable.

First and foremost, it is evident that death awareness is an integral, constitutive element of human consciousness, deeply embedded in our neuropsychological and cultural frameworks (Kesebir & Pyszczynski, 2012; Pyszczynski et al., 2015). Its biological elimination through advanced biogerontological interventions—such as senolytics and stem cell rejuvenation—does not, and indeed cannot, nullify its existential function. The questions of meaning, value, and authenticity that have always been framed by our finitude do not simply vanish with the extension of our chronological limits; instead, they are cast into a new, more complex and potentially more daunting light. The work of existential philosophers and psychologists remains critically relevant, not as a description of an obsolete condition, but as a guide to the fundamental structures of a conscious being confronting its own existence, regardless of its duration.



Consequently, in the context of hypothetical immortality, the function of death awareness undergoes a necessary and profound reformatting. It ceases to operate as an external chronological limiter and is reconstituted as an internal regulator of qualitative existence—the "existential alarm clock." This mechanism is hypothesized to be a cognitive-affective adaptation to the unique psychological perils of an endless lifespan: identity stagnation, existential boredom, and the "bad infinity" of undifferentiated time. Rather than signaling the end of

possibility, this internal alarm signals its squandering. It is the psychological manifestation of the imperative to remain dynamically engaged with the project of one's own being, a direct response to the pathologies of perpetuity (Svendsen, 2005; van der Meer et al., 2012).

The primary function of this alarm clock is to awaken the individual from the existential slumber induced by the prospect of unlimited time. It does so by generating subjective states of crisis, discomfort, and yearning that serve as catalysts for continuous meaning-seeking, deep personal transformation, and self-transcendence. Whether through identity crises that force the "death" and "rebirth" of the self (Sneed & Whitbourne, 2005), through the profound apathy that highlights an unlived life, or through the stimulus to dedicate one's vast time to a cause beyond the self (Vos, 2018), the alarm ensures that the quality of life remains the central focus. It is the engine of what we have termed "serial selves" and the guardian against a static, albeit endless, existence.

Therefore, we arrive at a central, paradoxical conclusion: even under conditions of biological immortality, a dialogue with mortality remains a crucial precondition for a truly meaningful, authentic, and fulfilling life. To live deeply and authentically, an immortal being must, in a psychological sense, retain a connection to the concept of death. It must remember the "stakes" of existence to prevent life from devolving into a directionless, valueless drift. The existential alarm clock is the mechanism of this remembrance. It is the internalization of mortality's lesson—that life gains its value from its choices, its commitments, and its depth of engagement—without the necessity of its biological execution.

In essence, to live fully, one must remember how to die. The conquest of biological death would not absolve us of this existential task; it would, in fact, make its conscious and continuous practice more vital than ever before. The ultimate challenge of immortality may not be the extension of life, but the perpetual re-creation of a life worth extending.

References:

Aphkhazava, D., Sulashvili, N., & Tkemaladze, J. (2025). Stem Cell Systems and Regeneration. Georgian Scientists, 7(1), 271–319. doi : https://doi.org/10.52340/gs.2025.07.01.26

Aphkhazava, D., Sulashvili, N., Maglakelidze, G., & Tkemaladze, J. (2025). Ageless Creatures: Molecular Insights into Organisms That Defy Aging. Georgian Scientists, 7(3), 346–396. doi : https://doi.org/10.52340/gs.2025.07.03.24

Chichinadze, K. N., & Tkemaladze, D. V. (2008). Centrosomal hypothesis of cellular aging and differentiation. Advances in Gerontology= Uspekhi Gerontologii, 21(3), 367-371.

Chichinadze, K., Lazarashvili, A., & Tkemaladze, J. (2013). RNA in centrosomes: structure and possible functions. Protoplasma, 250(1), 397-405.

Chichinadze, K., Tkemaladze, D., & Lazarashvili, A. (2012). New class of RNA and centrosomal hypothesis of cell aging. Advances in Gerontology= Uspekhi Gerontologii, 25(1), 23-28.

Chichinadze, K., Tkemaladze, J., & Lazarashvili, A. (2012). A new class of RNAs and the centrosomal hypothesis of cell aging. Advances in Gerontology, 2(4), 287-291.

Chichinadze, K., Tkemaladze, J., & Lazarashvili, A. (2012). Discovery of centrosomal RNA and centrosomal hypothesis of cellular ageing and differentiation. Nucleosides, Nucleotides and Nucleic Acids, 31(3), 172-183.

Elfettahi, A. E., & Tkemaladze, J.(2025). The Neuro-Hepatic-Affective Model (NHAM): A Systems Framework for Liver–Brain Modulation of Emotion in Precision Psychiatry. Preprints. doi : https://doi. org/10.20944/preprints202508, 1312, v1.

Jaba, T. (2022). Dasatinib and quercetin: short-term simultaneous administration yields senolytic effect in humans. Issues and Developments in Medicine and Medical Research Vol. 2, 22-31.

Kipshidze, M., & Tkemaladze, J. (2023). Comparative Analysis of drugs that improve the Quality of Life and Life Expectancy. Junior Researchers, 1(1), 184–193. doi : https://doi.org/10.52340/2023.01.01.19

Kipshidze, M., & Tkemaladze, J. (2023). The planaria Schmidtea mediterranea as a model system for the study of stem cell biology. Junior Researchers, 1(1), 194–218. doi : https://doi.org/10.52340/2023.01.01.20

Kipshidze, M., & Tkemaladze, J. (2024). Abastumani Resort: Balneological Heritage and Modern Potential. Junior Researchers, 2(2), 126–134. doi : https://doi.org/10.52340/jr.2024.02.02.12

Kipshidze, M., & Tkemaladze, J. (2024). Balneology in Georgia: traditions and modern situation. Junior Researchers, 2(2), 78–97. doi : https://doi.org/10.52340/jr.2024.02.02.09

Kipshidze, M., & Tkemaladze, J. (2024). Microelementoses-history and current status. Junior Researchers, 2(2), 108–125. doi : https://doi.org/10.52340/jr.2024.02.02.11

Lezhava, T., Monaselidze, J., Jokhadze, T., Kakauridze, N., Khodeli, N., Rogava, M., Tkemaladze, J., ... & Gaiozishvili, M. (2011). Gerontology research in Georgia. Biogerontology, 12, 87-91. doi : 10.1007/s10522-010-9283-6. Epub 2010 May 18. PMID: 20480236; PMCID: PMC3063552

Matsaberidze, M., Prangishvili, A., Gasitashvili, Z., Chichinadze, K., & Tkemaladze, J. (2017). TO TOPOLOGY OF ANTI-TERRORIST AND ANTI-CRIMINAL TECHNOLOGY FOR EDUCATIONAL PROGRAMS. International Journal of Terrorism & Political Hot Spots, 12.

Prangishvili, A., Gasitashvili, Z., Matsaberidze, M., Chkhartishvili, L., Chichinadze, K., Tkemaladze, J., ... & Azmaiparashvili, Z. (2019). SYSTEM COMPONENTS OF HEALTH AND INNOVATION FOR THE ORGANIZATION OF NANO-BIOMEDIC ECOSYSTEM TECHNOLOGICAL PLATFORM. Current Politics and Economics of Russia, Eastern and Central Europe, 34(2/3), 299-305.

Tkemaladze, J. (2025). The Tkemaladze Method: Mapping Cell Lineage with Mutant Mitochondrial Transfer. Preprints. https://doi.org/10.20944/preprints202509.2586.v1

Tkemaladze, J. (2023). Cross-senolytic effects of dasatinib and quercetin in humans. Georgian Scientists, 5(3), 138–152. doi : https://doi.org/10.52340/2023.05.03.15

Tkemaladze, J. (2023). Is the selective accumulation of oldest centrioles in stem cells the main cause of organism ageing?. Georgian Scientists, 5(3), 216–235. doi : https://doi.org/10.52340/2023.05.03.22

Tkemaladze, J. (2023). Long-Term Differences between Regenerations of Head and Tail Fragments in Schmidtea Mediterranea Ciw4. Available at SSRN 4257823.

Tkemaladze, J. (2023). Reduction, proliferation, and differentiation defects of stem cells over time: a consequence of selective accumulation of old centrioles in the stem cells?. Molecular Biology Reports, 50(3), 2751-2761. https://pubmed.ncbi.nlm.nih.gov/36583780/

Tkemaladze, J. (2023). Structure and possible functions of centriolar RNA with reference to the centriolar hypothesis of differentiation and replicative senescence. Junior Researchers, 1(1), 156–170. doi : https://doi.org/10.52340/2023.01.01.17

Tkemaladze, J. (2023). The centriolar hypothesis of differentiation and replicative senescence. Junior Researchers, 1(1), 123–141. doi : https://doi.org/10.52340/2023.01.01.15

Tkemaladze, J. (2024). Absence of centrioles and regenerative potential of planaria. Georgian Scientists, 6(4), 59–75. doi : https://doi.org/10.52340/gs.2024.06.04.08

Tkemaladze, J. (2024). Cell center and the problem of accumulation of oldest centrioles in stem cells. Georgian Scientists, 6(2), 304–322. doi : https://doi.org/10.52340/gs.2024.06.02.32

Tkemaladze, J. (2024). Editorial: Molecular mechanism of ageing and therapeutic advances through targeting glycative and oxidative stress. Front Pharmacol. 2024 Mar 6;14:1324446. doi : 10.3389/fphar.2023.1324446. PMID: 38510429; PMCID: PMC10953819.

Tkemaladze, J. (2024). Elimination of centrioles. Georgian Scientists, 6(4), 291–307. doi : https://doi.org/10.52340/gs.2024.06.04.25

Tkemaladze, J. (2024). Main causes of intelligence decrease and prospects for treatment. Georgian Scientists, 6(2), 425–432. doi : https://doi.org/10.52340/gs.2024.06.02.44

Tkemaladze, J. (2024). The rate of stem cell division decreases with age. Georgian Scientists, 6(4), 228–242. doi : https://doi.org/10.52340/gs.2024.06.04.21

Tkemaladze, J. (2025). A Universal Approach to Curing All Diseases: From Theoretical Foundations to the Prospects of Applying Modern Biotechnologies in Future Medicine. doi : http://dx.doi.org/10.13140/RG.2.2.24481.11366

Tkemaladze, J. (2025). Adaptive Systems and World Models. doi : http://dx.doi.org/10.13140/RG.2.2.13617.90720

Tkemaladze, J. (2025). Allotransplantation Between Adult Drosophila of Different Ages and Sexes. doi : http://dx.doi.org/10.13140/RG.2.2.27711.62884

Tkemaladze, J. (2025). Anti-Blastomic Substances in the Blood Plasma of Schizophrenia Patients. doi : http://dx.doi.org/10.13140/RG.2.2.12721.08807

Tkemaladze, J. (2025). Centriole Elimination as a Mechanism for Restoring Cellular Order. doi : http://dx.doi.org/10.13140/RG.2.2.12890.66248/1

Tkemaladze, J. (2025). Hypotheses on the Role of Centrioles in Aging Processes. doi : http://dx.doi.org/10.13140/RG.2.2.15014.02887/1

Tkemaladze, J. (2025). Limits of Cellular Division: The Hayflick Phenomenon. doi : http://dx.doi.org/10.13140/RG.2.2.25803.30249

Tkemaladze, J. (2025). Molecular Mechanisms of Aging and Modern Life Extension Strategies: From Antiquity to Mars Colonization. doi : http://dx.doi.org/10.13140/RG.2.2.13208.51204

Tkemaladze, J. (2025). Pathways of Somatic Cell Specialization in Multicellular Organisms. doi : http://dx.doi.org/10.13140/RG.2.2.23348.97929/1

Tkemaladze, J. (2025). Strategic Importance of the Caucasian Bridge and Global Power Rivalries. doi : http://dx.doi.org/10.13140/RG.2.2.19153.03680

Tkemaladze, J. (2025). The Epistemological Reconfiguration and Transubstantial Reinterpretation of Eucharistic Practices Established by the Divine Figure of Jesus Christ in Relation to Theological Paradigms. doi : http://dx.doi.org/10.13140/RG.2.2.28347.73769/1

Tkemaladze, J. (2025). Transforming the psyche with phoneme frequencies "Habere aliam linguam est possidere secundam animam". doi : http://dx.doi.org/10.13140/RG.2.2.16105.61286

Tkemaladze, J. (2025). Uneven Centrosome Inheritance and Its Impact on Cell Fate. doi : http://dx.doi.org/10.13140/RG.2.2.34917.31206

Tkemaladze, J. (2025). Ze World Model with Predicate Actualization and Filtering. doi : http://dx.doi.org/10.13140/RG.2.2.15218.62407

Tkemaladze, J. (2025). Ze метод создания пластичного счетчика хронотропных частот чисел бесконечного потока информации. doi : http://dx.doi.org/10.13140/RG.2.2.29162.43207

Tkemaladze, J. (2025). A Novel Integrated Bioprocessing Strategy for the Manufacturing of Shelf-Stable, Nutritionally Upgraded Activated Wheat: Development of a Comprehensive Protocol, In-Depth Nutritional Characterization, and Evaluation of Biofunctional Properties. Longevity Horizon, 1(3). doi : https://doi.org/10.5281/zenodo.16950787

Tkemaladze, J. (2025). Achieving Perpetual Vitality Through Innovation. doi : http://dx.doi.org/10.13140/RG.2.2.31113.35685

Tkemaladze, J. (2025). Activated Wheat: The Power of Super Grains. Preprints. doi : https://doi.org/10.20944/preprints202508.1724.v1

Tkemaladze, J. (2025). Adaptive Cognitive System Ze. Longevity Horizon, 1(3). doi : https://doi.org/10.5281/zenodo.15309162

Tkemaladze, J. (2025). Aging Model Based on Drosophila melanogaster: Mechanisms and Perspectives. Longevity Horizon, 1(3). doi : https://doi.org/10.5281/zenodo.14955643

Tkemaladze, J. (2025). Aging Model-Drosophila Melanogaster. doi : http://dx.doi.org/10.13140/RG.2.2.16706.49607

Tkemaladze, J. (2025). An Interdisciplinary Study on the Causes of Antediluvian Longevity, the Postdiluvian Decline in Lifespan, and the Phenomenon of Job's Life Extension. Preprints. doi : https://doi.org/10.20944/preprints202509.1476.v1

Tkemaladze, J. (2025). Anatomy, Biogenesis, and Role in Cell Biology of Centrioles. Longevity Horizon, 1(2). doi : https://doi.org/10.5281/zenodo.14742232

Tkemaladze, J. (2025). Anti-Blastomic Substances in the Plasma of Schizophrenia Patients: A Dual Role of Complement C4 in Synaptic Pruning and Tumor Suppression. Longevity Horizon, 1(3). doi : https://doi.org/10.5281/zenodo.15042448

Tkemaladze, J. (2025). Asymmetry in the Inheritance of Centrosomes/Centrioles and Its Consequences. Longevity Horizon, 1(2). doi : https://doi.org/10.5281/zenodo.14837352

Tkemaladze, J. (2025). Centriole Elimination: A Mechanism for Resetting Entropy in the Cell. Longevity Horizon, 1(2). doi : https://doi.org/10.5281/zenodo.14876013

Tkemaladze, J. (2025). Concept to The Alive Language. Longevity Horizon, 1(1). doi : https://doi.org/10.5281/zenodo.14688792

Tkemaladze, J. (2025). Concept to The Caucasian Bridge. Longevity Horizon, 1(1). doi : https://doi.org/10.5281/zenodo.14689276

Tkemaladze, J. (2025). Concept to The Curing All Diseases. Longevity Horizon, 1(1). doi : https://doi.org/10.5281/zenodo.14676208

Tkemaladze, J. (2025). Concept to The Eternal Youth. Longevity Horizon, 1(1). doi : https://doi.org/10.5281/zenodo.14681902

Tkemaladze, J. (2025). Concept to The Food Security. Longevity Horizon, 1(1). doi : https://doi.org/10.5281/zenodo.14642407

Tkemaladze, J. (2025). Concept to the Living Space. Longevity Horizon, 1(1). doi : https://doi.org/10.5281/zenodo.14635991

Tkemaladze, J. (2025). Concept to The Restoring Dogmas. Longevity Horizon, 1(1). doi : https://doi.org/10.5281/zenodo.14708980

Tkemaladze, J. (2025). Differentiation of Somatic Cells in Multicellular Organisms. Longevity Horizon, 1(2). doi : https://doi.org/10.5281/10.5281/zenodo.14778927

Tkemaladze, J. (2025). Direct Reprogramming of Somatic Cells to Functional Gametes in Planarians via a Novel In Vitro Gametogenesis Protocol. Preprints. doi : https://doi.org/10.20944/preprints202509.1071.v1

Tkemaladze, J. (2025). Induction of germline-like cells (PGCLCs). Longevity Horizon, 1(3). doi : https://doi.org/10.5281/zenodo.16414775

Tkemaladze, J. (2025). Long-Lived Non-Renewable Structures in the Human Body. doi : http://dx.doi.org/10.13140/RG.2.2.14826.43206

Tkemaladze, J. (2025). Mechanisms of Learning Through the Actualization of Discrepancies. Longevity Horizon, 1(3). doi : https://doi.org/10.5281/zenodo.15200612

Tkemaladze, J. (2025). Memorizing an Infinite Stream of Information in a Limited Memory Space: The Ze Method of a Plastic Counter of Chronotropic Number Frequencies. Longevity Horizon, 1(3). doi : https://doi.org/10.5281/zenodo.15170931

Tkemaladze, J. (2025). Molecular Insights and Radical Longevity from Ancient Elixirs to Mars Colonies. Longevity Horizon, 1(2). doi : https://doi.org/10.5281/zenodo.14895222

Tkemaladze, J. (2025). Ontogenetic Permanence of Non-Renewable Biomechanical Configurations in Homo Sapiens Anatomy. Longevity Horizon, 1(3). doi : https://doi.org/10.5281/zenodo.15086387

Tkemaladze, J. (2025). Protocol for Transplantation of Healthy Cells Between Adult Drosophila of Different Ages and Sexes. Longevity Horizon, 1(2). doi : https://doi.org/10.5281/zenodo.14889948

Tkemaladze, J. (2025). Replicative Hayflick Limit. Longevity Horizon, 1(2). doi : https://doi.org/10.5281/zenodo.14752664

Tkemaladze, J. (2025). Solutions to the Living Space Problem to Overcome the Fear of Resurrection from the Dead. doi : http://dx.doi.org/10.13140/RG.2.2.34655.57768

Tkemaladze, J. (2025). The Centriolar Theory of Differentiation Explains the Biological Meaning of the.

Tkemaladze, J. (2025). The Centriole Paradox in Planarian Biology: Why Acentriolar Stem Cells Divide and Centriolar Somatic Cells Do Not. doi : https://doi.org/10.20944/preprints202509.0382.v1

Tkemaladze, J. (2025). The Concept of Data-Driven Automated Governance. Georgian Scientists, 6(4), 399–410. doi : https://doi.org/10.52340/gs.2024.06.04.38

Tkemaladze, J. (2025). The Stage of Differentiation Into Mature Gametes During Gametogenesis in Vitro. Longevity Horizon, 1(3). doi : https://doi.org/10.5281/zenodo.16808827

Tkemaladze, J. (2025). The Tkemaladze Method maps cell lineage with mutant mitochondrial transfer. Longevity Horizon, 1(4). doi : https://doi.org/10.5281/zenodo.17236869

Tkemaladze, J. (2025). The Tkemaladze Method: A Modernized Caucasian Technology for the Production of Shelf-Stable Activated Wheat with Enhanced Nutritional Properties. Longevity Horizon, 1(3). doi : https://doi.org/10.5281/zenodo.16905079

Tkemaladze, J. (2025). Theory of Lifespan Decline. Longevity Horizon, 1(3). doi : https://doi.org/10.5281/zenodo.17142909

Tkemaladze, J. (2025). Through In Vitro Gametogenesis—Young Stem Cells. Longevity Horizon, 1(3). doi : https://doi.org/10.5281/zenodo.15847116

Tkemaladze, J. (2025). Unlocking the Voynich Cipher via the New Algorithmic Coding Hypothesis. Longevity Horizon, 1(3). doi : https://doi.org/10.5281/zenodo.17054312

Tkemaladze, J. (2025). Voynich Manuscript Decryption: A Novel Compression-Based Hypothesis and Computational Framework. doi : https://doi.org/10.20944/preprints202509.0403.v1

Tkemaladze, J. (2025). Why do planarian cells without centrioles divide and cells with centrioles do not divide?. Longevity Horizon, 1(3). doi : https://doi.org/10.5281/zenodo.17054142

Tkemaladze, J. (2025). Гаметогенез In Vitro: современное состояние, технологии и перспективы применения. Research Gate. doi : http://dx.doi.org/10.13140/RG.2.2.28647.36000

Tkemaladze, J. Systemic Resilience and Sustainable Nutritional Paradigms in Anthropogenic Ecosystems. doi : http://dx.doi.org/10.13140/RG.2.2.18943.32169/1

Tkemaladze, J. V., & Chichinadze, K. N. (2005). Centriolar mechanisms of differentiation and replicative aging of higher animal cells. Biochemistry (Moscow), 70, 1288-1303.

Tkemaladze, J., & Apkhazava, D. (2019). Dasatinib and quercetin: short-term simultaneous administration improves physical capacity in human. J Biomedical Sci, 8(3), 3.

Tkemaladze, J., & Chichinadze, K. (2005). Potential role of centrioles in determining the morphogenetic status of animal somatic cells. Cell biology international, 29(5), 370-374.

Tkemaladze, J., & Chichinadze, K. (2010). Centriole, differentiation, and senescence. Rejuvenation research, 13(2-3), 339-342.

Tkemaladze, J., & Gakely, G. (2025). A Novel Biotechnological Approach for the Production of Shelf-Stable, Nutritionally Enhanced Activated Wheat: Protocol Development, Nutritional Profiling, and Bioactivity Assessment. doi : https://doi.org/10.20944/preprints202508.1997.v1

Tkemaladze, J., & Gakely, G. (2025). Induction of de novo centriole biogenesis in planarian stem cells. Longevity Horizon, 1(4). doi : https://doi.org/10.5281/zenodo.17283229

Tkemaladze, J., & Samanishvili, T. (2024). Mineral ice cream improves recovery of muscle functions after exercise. Georgian Scientists, 6(2), 36–50. doi : https://doi.org/10.52340/gs.2024.06.02.04

Tkemaladze, J., Gakely, G., Gegelia, L., Papadopulo, I., Taktakidze, A., Metreveli, N., ... & Maglakelidze, U. (2025). Production of Functional Gametes from Somatic Cells of the Planarian Schmidtea Mediterranea Via in Vitro Gametogenesis. Longevity Horizon, 1(3). doi : https://doi.org/10.5281/zenodo.17131291

Tkemaladze, J., Tavartkiladze, A., & Chichinadze, K. (2012). Programming and Implementation of Age-Related Changes. In Senescence. IntechOpen.

Tkemaladze, Jaba and Kipshidze, Mariam, Regeneration Potential of the Schmidtea Mediterranea CIW4 Planarian. Available at SSRN: https://ssrn.com/abstract=4633202 or http://dx.doi.org/10.2139/ssrn.4633202

Прангишвили, А. И., Гаситашвили, З. А., Мацаберидзе, М. И., Чичинадзе, К. Н., Ткемаладзе, Д. В., & Азмайпарашвили, З. А. (2017). К топологии антитеррористических и антикриминальных технологии для образовательных программ. В научном издании представлены материалы Десятой международной научно-технической конфе-ренции «Управление развитием крупномасштабных систем (MLSD'2016)» по следующим направле-ниям:• Проблемы управления развитием крупномасштабных систем, включая ТНК, Госхолдин-ги и Гос-корпорации., 284.

Прангишвили, А. И., Гаситашвили, З. А., Мацаберидзе, М. И., Чхартишвили, Л. С., Чичинадзе, К. Н., & Ткемаладзе, Д. В. (2017). & Азмайпарашвили, ЗА (2017). Системные составляющие здравоохранения и инноваций для организации европейской нано-биомедицинской екосистемной технологической платформы. Управление развитием крупномасштабных систем MLSD, 365-368.

Ткемаладзе, Д. (2025). Асимметрия в наследовании центросом/центриолей и ее последствия. doi : http://dx.doi.org/110.13140/RG.2.2.34917.31206

Ткемаладзе, Д. (2025). Гаметогенез in vitro (IVG)-Этап дифференцировки в зрелые гаметы. doi : http://dx.doi.org/10.13140/RG.2.2.20429.96482

Ткемаладзе, Д. (2025). Дифференциация соматических клеток многоклеточных животных. doi : http://dx.doi.org/10.13140/RG.2.2.23348.97929/1

Ткемаладзе, Д. (2025). Индукция примордиальных клеток, подобных зародышевым клеткам (PGCLCs) современные достижения, механизмы и перспективы применения. doi : http://dx.doi.org/10.13140/RG.2.2.27152.32004

Ткемаладзе, Д. (2025). Репликативный Лимит Хейфлика. doi : http://dx.doi.org/10.13140/RG.2.2.25803.30249

Ткемаладзе, Д. (2025). Элиминация Центриолей: Механизм Обнуления Энтропии в Клетке. doi : http://dx. doi. org/10.13140/RG.2.2.12890.66248/1

Ткемаладзе, Д. В., & Чичинадзе, К. Н. (2005). Центриолярные механизмы дифференцировки и репликативного старения клеток высших животных. Биохимия, 70(11), 1566-1584.

Ткемаладзе, Д., Цомаиа, Г., & Жоржолиани, И. (2001). Создание искусственных самоадаптирующихся систем на основе Теории Прогноза. Искусственный интеллект. УДК 004.89. Искусственный интеллект. УДК 004.89.

Чичинадзе, К. Н., & Ткемаладзе, Д. В. (2008). Центросомная гипотеза клеточного старения и дифференциации. Успехи геронтологии, 21(3), 367-371.

Чичинадзе, К., Ткемаладзе, Д., & Лазарашвили, А. (2012). Новый класс рнк и центросомная гипотеза старения клеток. Успехи геронтологии, 25(1), 23-28