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Review Article

Evaluating Anomalous Health Incidents of the Havana Syndrome: The Case for a Structured Qualitative and Quantitative Symptom Assessment Instrument

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Abstract

Anomalous Health Incidents (AHIs) of the colloquially termed "Havana Syndrome" represent a challenging constellation of subjective and objective neurocognitive, vestibular, and autonomic features, with potential links to directed energy exposure. Diagnostic efforts have been hindered by heterogeneity in symptom reporting and the absence of standardized assessment tools. This paper proposes the development of an Anomalous Health Incident Symptom Questionnaire (AHISQ), modeled in part upon the McGill Pain Questionnaire, to facilitate structured, multidimensional characterization of symptom phenomenology. Integrating qualitative descriptors with quantitative metrics, the AHISQ would support reproducible data collection, epidemiological modeling, differential diagnosis, and forensic analysis. The paper details proposed domains of assessment, including sensory, cognitive-affective, functional, temporal, and contextual parameters, and advocates for digital integration, adaptive questioning, and multimodal validation incorporating neuroimaging, physiological, and biometric data. The AHISQ is presented as a tool to inform causal inference frameworks such as the Bradford-Hill criteria and PECOTS model, while addressing ethical imperatives for rigorous, inclusive, and hypothesis-neutral assessment. Ultimately, this approach aligns with a precision neurophenomenological paradigm, bridging subjective experience with objective analysis, and fostering improved diagnostic fidelity, patient care, and national security readiness.

Keywords: *Havana Syndrome; Anomalous Health Incidents; Neurocognitive Assessment; Differential Diagnosis; Presumptive Risk*

Introduction: Limitations of Current Symptom Assessment in AHIs

Anomalous health incidents (AHIs) of the colloquially labeled "Havana Syndrome" have presented a complex diagnostic challenge for both clinicians and government entities. Individuals reporting these incidents, were initially United States (U.S.) and Canadian personnel serving at the U.S. consulate in Havana, Cuba, and subsequently other individuals serving in similar roles in multiple locales (e.g. Austria, Germany, Russia, Vietnam, and within the continental U.S.). All have described acute onset of a constellation of subjective symptoms, including directional auditory phenomena, vertigo, cognitive disturbances, pressure sensations, which are accompanied by objective neurological, vestibular, and autonomic disturbances.

Our group [1,2], and the National Academies of Sciences [3] have posited directed electromagnetic (i.e. radiofrequency and/or rapidly pulsed microwave) energy as a probable cause; although in other cases, evaluations have considered environmental, pre- and/or co-morbid conditions, and socio-psychogenic etiologies [4]. Differential diagnoses of AHIs are reliant upon rigorous objective testing of neurovestibular, and cognitive function, assessment of prior and current medical conditions, review of situational factors and variables; and correlation of these findings with individuals' reports of subjective symptoms [5]. However, this latter aspect can be problematic due to limitations of current symptom reporting and evaluation methods.

Indeed, an extant barrier to understanding AHIs has been the variability in symptom reporting. The reliance on narrative of subjective experiences, often obtained retrospectively, in the context of psychological stress or trauma, may introduce cognitive bias, suggestibility, and recall distortion into the corpus of data [6]. Absent some standardized instrument, clinicians and researchers must resort to comparing symptoms across cases using heterogeneous, and often non-commensurate patient descriptions and clinical notes.

The difficulties of this approach are compounded by the subjective and often non-specific nature of the symptoms themselves. Vertigo, headache, pressure sensations, fatigue, tinnitus, and cognitive fog are frequent complaints in veritable AHIs, but are also common in post-concussive syndromes, long COVID, Lyme disease, primary or secondary vestibulitis, sinusitis, and functional neurological disorders (FND). To differentiate AHI-associated symptoms from other morbidities (including idiopathic or FND phenomena), it is important, if not essential to establish a standard, stable, reproducible lexicon and measurement scheme [7]. Such a protocol should include symptom identification and severity rating, as well as characterization of qualitative features, temporal dynamics, and perceived contextual factors.

Toward this goal it is proposed that the development and application of a robust, validated, and systematically administered qualitative and quantitative questionnaire is needed. Such a tool would be useful to more accurately categorize the phenomenology of AHIs; and if taken with other assessments, including recently proposed AI-based meta-data assimilation and analyses methods [8], could fortify and guide clinical management, support epidemiological and forensic efforts to elucidate possible causation, and improve diagnoses and care of afflicted patients.

Lessons from pain assessment: The McGill Pain Questionnaire Model

The McGill Pain Questionnaire (MPQ), developed by Ronald Melzack and Warren Torgerson in 1971 [9], and available in both long- and short-form versions, revolutionized pain assessment by introducing a multidimensional instrument that captures both the qualities and intensity of a patient's individual pain experience [10]. Rather than relying solely on visual analog and/or numeric rating scales, the MPQ elicits descriptors across sensory, affective, and evaluative domains, incorporating spatial mapping, temporal assessment, and pain behavior indices, which contribute to a more nuanced, clinically actionable understanding of both each patient's condition, and how a particular patient may "fit" within broader pathophysiological and psychosocial categorizations of pain [11].

This integrative model, which conjoins qualitative descriptors with quantitative metrics, could afford a possible framework for developing a parallel instrument for symptomatologic assessment of AHIs. Such an instrument would move beyond binary checklists or subjective impressions, offering a structured and replicable method for data collection that can be applied across cases and longitudinally within individuals. These data can be used to develop symptom profiles that when taken with objective signs, might serve to better define features that are pathognomic to AHI, and distinguish these from functional mimics or psychogenic expressions.

However, the MPQ is not without limitation(s) and constraints. At its core, the MPQ relies on the assumption that patients can accurately and consistently describe their (pain) symptoms using a predefined set of English language-based descriptors [12]. This presumes linguistic fluency, cognitive capacity, and cultural familiarity with the semantic nuance of words like "throbbing", "gnawing", or "lancinating".

Patients with neurocognitive impairments may struggle to map their experience onto the MPQ lexicon [13]. Moreover, many descriptors overlap semantically, creating ambiguity and interpretive variance across raters and settings [14]. Lexical richness does not necessarily equate with clinical clarity.

The MPQ provides a temporal snapshot of pain experience; yet symptoms can change in intensity, quality, and affective tone over time. The questionnaire does not capture temporal variability well, nor does it incorporate contextual factors such as movement, mood fluctuations, environmental triggers, or circadian variation that modulate pain perception and expression. As a result, it may underrepresent or misrepresent fluctuations in symptoms, particularly if chronic or episodic [15].

Although the MPQ attempts to assess affective dimensions, emotions such as despair, fear, existential dread, or anger are rarely captured in sufficient depth. The cognitive dimensions of catastrophizing, attentional salience, and perceived control are also underrepresented [16]. These elements are crucial in understanding the phenomenal impact of symptoms and may also provide indicators of psychophysiological comorbidity. Additionally, the MPQ is content- and format-fixed, and therefore may unintentionally introduce bias or fail to accommodate the expression styles of diverse populations [17]. Lastly, clinicians' interpretation of the MPQ results may be influenced by heuristics or stereotypes, leading to disparities in diagnosis and treatment [18].

Cognizance of these limitations is important to developing an AHISQ that mitigates these constraints. Toward such ends an overall aim would be to preserve the strengths of the MPQ's structured multidimensionality while expanding its reach, depth, and alignment with contemporary neurocognitive science. For example, digitization would enable adaptive questionnaire formats that respond dynamically to patient inputs, branching follow-up questions based on initial descriptors, capturing symptom trajectories in real time (and allowing translation of the tool into multiple languages [19]). Voice-to-text and image-based symptom diaries could complement text-driven formats, enhancing inclusivity and ecological validity. Integrating natural language processing (NLP) can allow for more nuanced capture of patients' spontaneous narratives [20].

Validated scales for anxiety, depression and cognitive self-appraisal are absent in the MPQ, and these should be integrated to afford a more holistic approach to symptom assessment. These could be embedded into digital symptom questionnaires to yield a more comprehensive profile that links somatic symptoms to psychological constructs. To this latter point, symptom assessment should be coupled to objective indicators, and combining MPQ-style subjective reports with neuroimaging (e.g. fMRI, DTI; see for example studies by Verma., *et al*. [21]), neurophysiological (EEG, QST), and/or autonomic markers (e.g. heart rate variability, HRV; skin conductance, etc.) could enable multimodal evaluation. This would enhance diagnostic resolution and help distinguish between constellation types that may appear phenomenologically similar, but which differ mechanistically.

Bridging the gaps(s): The utility of an AHI symptom questionnaire (AHISQ)

To systematically capture the complex phenomenology of AHIs, the proposed design of an Anomalous Health Incident Symptom Questionnaire (AHISQ) could be modeled after the MPQ in principle and structure, but embellished to de-limit the aforementioned precincts to entail and obtain:

1. Sensory descriptors: Terms describing auditory phenomena ("buzzing", "pulsing", "chirping"), vestibular effects ("spinning", "tumbling", "tilting"), visual anomalies ("flashing", "blurring"), and somatic sensations ("pressure", "vibration", "tingling").
2. Cognitive and affective descriptors: Subjective reports of confusion, disorientation, difficulty concentrating, memory disruption, anxiety, depression, or dissociation.
3. Spatial and temporal mapping: Documentation of where in the body and/or environment sensations are perceived; onset dynamics (sudden vs. gradual); duration, frequency, and triggering contexts and factors.

4. Functional impact indices: Measures of impact on physical state(s) and capabilities (e.g. movement abilities and motor coordination; autonomic processes including gastrointestinal and cardiovascular function; endocrine and immune function, etc.), occupational performance, activities of daily living, and psychosocial functioning.
5. Biopsychosocial context: Collection of potentially relevant environmental, psychological, and sociocultural factors, including perceived threat levels, occupational and other exposures, and recent stressors.

These domains could be scored along Likert scales and/or intensity-frequency grids. Responses could be digitally integrated with geolocation metadata and biometric information for multi-domain correlative analyses. Ideally, this tool would be modular, with short forms available for clinical screening and long forms for research-level detail.

Critically, this instrument would need to undergo iterative (content and construct) validation using both clinical and control populations, including individuals with known neuropsychiatric conditions, vestibular disorders, and idiopathic symptom clusters. Pilot testing, followed by factor analysis and inter-rater reliability evaluation, would be essential for such validation.

Developing a "Bigger picture"

Just as the MPQ helped to deconstruct pain into its sensory and affective components, a hybrid qualitative-quantitative approach to AHIs offers several distinct advantages; these include:

- Phenomenological fidelity: By allowing respondents to choose descriptors that best approximate their lived experience, the instrument can capture the subtleties of AHI presentations without forcing symptoms to fit into conventional clinical categories.
- Pattern recognition and clustering: Aggregated data from the AHISQ can be subjected to statistical methods such as cluster analysis, latent class analysis, or principal component analysis, potentially revealing subtypes of AHIs with shared features.
- Epidemiological surveillance: With standardized symptom data, cases can be meaningfully compared across time and space, aiding in the detection of potential exposure clusters, propagation vectors, or geographic trends.
- Support for causation hypotheses: Should particular symptom profiles correspond with exposure to specific frequencies, energies, or environmental conditions, these patterns could guide forensic investigations and experimental replication efforts.
- Diagnostic differentiation: The inclusion of specific sensory and cognitive descriptors could help discriminate AHIs from conditions like persistent post-concussive syndrome, vestibular migraine, or conversion disorder-thereby enhancing diagnostic clarity and preventing misattribution.

These marry well with current methods - such as Bradford-Hill criteria - employed for evaluation and determination of presumptive risk of exposure to factors that pose detrimental health effects contributory to long-term disability [22], and which were utilized, together with other approaches for determining correlation and inferred causality (e.g. the PECOTS framework; see below) to assess initial cases of AHI from the Havana cohort [1,2]. The Bradford-Hill criteria are a cornerstone for inferring causality in those instances where direct experimental manipulation is infeasible or unethical (See table 1).

The nine criteria (viz. strength, consistency, specificity, temporality, biological gradient, plausibility, coherence, experimental evidence, and analogy) allow evaluative associations between exposure to some putatively injurious factor and an outcome.

Biologic Plausibility: The presumed evocative factors must exist; must exhibit properties consistent with observed effects; and observed effects must be consistent with known biological processes and mechanisms.
Temporality: The observed/reported effects must have occurred following presentation of/exposure to the possible evocative factor.
Dose-response Relationality: There is a demonstrable correlation between extent/duration of exposure to the presumed offending factor and the extent and/or severity of observed signs and reported symptoms.
Coherence of Evidence: Any and all findings must be consistent with factual and relational information relevant to the factors involved. Gaps and inconsistencies in information should be explicable and accountable and not detract from and/or weaken the overall relationship of putative evocative factor(s) and observed/reported effect(s).
Specificity of Association: The relationship of the putative evocative factor(s), situational and temporal variables of possible exposure, and observed/reported effects must be sufficiently robust so as to "rule-in" the viability of exposure and risk of causing defined effects; but not necessarily "rule out" other factors (see Alternative Considerations, below).
Strength of Association: There must be a trend toward valid, reproducible and reliable correlation between putative evocative factors, exposure parameters (temporality, extent, etc.), observed/reported effects, and known mechanisms of such effect(s).
Consideration of Experimental Evidence: There should be evaluation and corroboration of any research-based laboratory findings about the putative evocative factor(s) and observed reported effects.
Reproducibility of Findings: Experimental results (if available) and/or field findings should be replicable, as possible, under conditions of identical, similar or generally equivalent settings, circumstances and conditions. (Note however, that this criterion is often difficult, if not impossible to accommodate, particularly if specific aspects of the putatively evocative factor remain unknown or incompletely defined).
Consideration of Alternate Explanation(s): Principles of parsimony should be applied to any and all evidence, to regard possibilities for variety of any/all factors that could produce/evoke similar and/or equivalent effects under related circumstances. Ideally, consideration of such alternative explanations should be able to be "ruled out" by the body of extant evidence in accordance with the other criteria (see, Specificity of Association; and Strength of Association, above).

Table 1: *Bradford-Hill criteria.*

For AHIs, a primary challenge to date has been a paucity of definitive exposure metrics. In light of this, systematic symptom assessment becomes a strong element in determining correlation and presumptive causation. A rigorously developed, standardized symptom questionnaire, employing both qualitative and quantitative dimensions, could serve to inform several of the Bradford-Hill criteria, most directly consistency, specificity, and temporality.

To this latter point, temporality is a non-negotiable element of causal inference: simply put, effect(s) must follow exposure. However, caution is warranted to avoid temporal conclusions that succumb to the *post-hoc* fallacy (i.e. that mere antecedence implies causality). A structured questionnaire that includes temporal mapping (e.g. symptom onset latency, duration, and progression) would be invaluable in demonstrating whether symptom development aligns with known or suspected exposure events. Obviously, such data must be collected

retrospectively; but systematic protocols can minimize recall bias and preserve temporal fidelity. Relating symptom evolution to objective data (e.g. travel logs, proximity to suspected stimuli, operational history of potential exposure) would significantly improve the analytic integrity of temporality assessments.

When linked with neuroimaging, neurophysiological, or biomarker data, the aggregation and harmonization of case data facilitating cross-site comparison could also support biological plausibility, coherence, and consistency, as viable determinants of causal relationality. Of course, the presence of a symptom does not inherently signify pathology, nor does a cluster of symptoms necessarily indicate a shared etiology. Nevertheless, patterns do matter. By employing factor analysis on data from a structured instrument, clinicians and researchers can identify specific symptom constellations that correlate with suspected exposure windows and environments, which could help distinguish unique profiles of AHI, thereby enhancing the specificity of diagnostic thresholds.

Once validated, the questionnaire could be used for cohort risk profiling, essentially categorizing individuals into presumptive, probable, or unlikely exposure groups based on symptom concordance with known AHI profiles. This would be critical for:

- Prioritizing diagnostic workups and specialist referrals.
- Determining eligibility for medical surveillance or compensation.
- Informing occupational risk mitigation tactics and strategies.
- Supporting epidemiological modeling of affected populations.

This information could then be engaged in a framework for presumptive service connection of AHI due to service-related exposure, such as an appropriately detailed PECOTS (Patient population, Exposure, Comparator(s), Outcome(s), Timing, Setting) system (As presented in table 2, see also, above), which could be used in concert with other risk-evaluative approaches and tools [23], e.g. those employed by the National Toxicological Program (NTP [24]) and/or World Health Organization (WHO; [25]).

The following criteria must be evaluated and applied to the particulars of Patient population (P); Exposures (E), Comparators (C), Outcomes (O), Timing (T), and Settings(S)
Establish Mechanism of Effect(s): Assess relationship between exposure to putative evocative factor(s) and observed effects as demonstrated by *in vitro* laboratory/research studies.*
Establish Biological Activity: Assess relationship between exposure to evocative factor(s) and observed effects in *in vivo* (animal) studies.*
Establish Biological Activity in Humans: Assess existing information about the validity of research findings regarding the relationship of the putative evocative factor(s) and known (biological/physiological/psychological/behavioral) effects in humans.**
Establish Operational Exposure: Assess evidence of exposure to putative evocative factor(s) in identified operational missions and settings.
Establish Operational Risk: Assess evidence that particular operational personnel may have been exposed to the putatively evocative factor(s), which is under consideration for presumption to be correlated to observed/reported effects in comparison to other personnel who do not meet setting, situational and/or circumstantial criteria for operational exposure.
Determine Overall Level of Evidence: Based upon the aforementioned assessment(s), establish an overall level (i.e. probabilistic likelihood) of presumed operational exposure to the putative evocative factor(s).
*= Such establishment(s) may be difficult or impossible due to paucity of prior studies/data.
**=Such establishment may be difficult when case(s) represent new/novel presumed exposure to putatively evocative factor(s), and/or if the putatively evocative factor(s) represent novel stimuli, settings, or circumstances.

Table 2: *PECOTS framework.*

Taken together, these protocols and data could be employed as a scientific best practices paradigm for AHI evaluation, diagnoses and care that is applicable in national security, intelligence, and policy contexts.

Operational and ethical considerations: Toward precision neurophenomenology

From operational and national security perspectives, persistent ambiguity surrounding AHIs has had, and will continue to incur (negative) implications for duty readiness, occupational health policies, and interagency trust. An AHISQ, when deployed as part of a standardized clinical protocol, could dis-ambiguate AHI evaluation, and in so doing, streamline triage decisions, facilitate coordinated multidisciplinary care across various governmental branches, inform return-to-duty criteria, and enable valid determinations of disability to undergird provision of economic support for those who are thus disabled.

The application of such an instrument should be situated within a framework of responsible multi-disciplinary scientific investigation, wherein findings are subject to peer review, transparency, and iterative refinement and revision. Importantly, the development of an AHISQ must remain agnostic to presumed etiology: whether the ultimate explanation is biophysical, environmental, or psychogenic, a structured instrument should facilitate hypothesis testing rather than bias or prejudge any result(s).

Too often, symptom reports have been superficially dichotomized into "physical" or "psychogenic" classifications without sufficient depth of insight or interpretive nuance. This has led to stigmatization, diagnostic overshadowing, and bureaucratic impasses in the provision and delivery of care.

Ethically, the primacy of patients' best interests demands clinical attention to both objective aspects of their condition, and those ways that it manifests in, and affects the subjective domains and dimensions of their life world(s). Toward such ends, it is incumbent upon the scientific and medical communities to provide fair and comprehensive assessment methods that are valuable in their ability to corroborate patient experiences while still rigorously pursuing empirical validity.

In recent years, discourses in neuroethics have advocated the use of a "precision neurophenomenological" approach, wherein subjective experience is not dismissed as inherently unmeasurable, but is instead regarded as a domain amenable - and important - to systematic inquiry of neurocognitive processes [26]. I opine this to be of merit, given that the brain is, after all, the focal interpreter of an individual's lived experience, and its perturbations, whether from external insult or internal dysfunction, manifest first and foremost as alterations in subjective perception and function. To be sure, the nature of first-person experience is always entirely subjective, and, as noted in the perdurable "phenomenological dilemma", difficulty often lies in attempting to translate subjective understanding to objective explanation [27]. By providing explanatory guidance and empirical correlation, an MPQ-derived AHISQ may be of use and value in bridging the extant gap between subjectivity and objectivity that plagues research and treatment of AHIs.

Conclusion

An AHISQ should not be viewed or employed as a stand-alone assessment tool. To the contrary, it will be important to yoke such an instrument to each patient's meta-data and neuroimaging studies, and to then combine all patients' data in a repository database from which computational techniques and technologies may be used to derive patterns of symptoms, signs, and etiologic and pathogenic factors that can be formalized and standardized. This data base can be utilized to develop (1) improved individual-to-group, and group-to-individual indices for correlative evaluation of neuroimaging studies; and (2) high-validity biomarkers, which can serve as easily accessible methods for assessment and diagnoses in those settings and circumstances (e.g. field operations; overseas mission deployments) wherein patients are not able to undergo advanced neuroimaging and/or other technology-dependent testing.

Anomalous health incidents represent a multifaceted challenge at the intersection of human experience, medicine, and national security. But while multiplex in scope, impact, implication, and import, the clinical imperative is unifocal: namely, that it is vital to develop tools that enable assessment, categorization, and tracking of symptoms with fidelity, validity, and reproducibility. By integrating qualitative descriptors with quantitative metrics, the proposed AHISQ could enhance diagnostic accuracy, inform therapeutic decisions, and support the larger goals of epidemiological surveillance, forensic investigation, and fortified detection and deterrence for national defense. But perhaps most importantly, such an AHISQ could provide means to systematically address the experiences of those affected, bridging the often-contentious schism between anecdote and analysis. In so doing, the scientific integrity and ethical obligations of medicine can be upheld, both overarchingly, and with specific responsibility to care for those individuals who have incurred injury while in the service of their country.

Disclaimer

The views and opinions presented in this essay are those of the author, and do not necessarily reflect those of the U.S. government, Department of Defense, or the National Defense University.

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