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# Application of the Sleep C.A.L.M. Tool for Assessing Nocturia in a Large Nationally Representative Cohort

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**Purpose:** Nocturia significantly impacts patients' quality of life but remains insufficiently evaluated and treated. The "Sleep C.A.L.M." system categorizes the factors thought to collectively reflect most underlying causes of nocturia (Sleep disorders, Comorbidities, Actions [i.e., modifiable patient behaviors such as excess fluid intake], Lower urinary tract dysfunction, and Medications). The purpose of this study was to assess the association of nocturia with the Sleep C.A.L.M. categories using a nationally representative dataset.

**Methods:** Retrospective analysis of the National Health and Nutrition Examination Survey from 2013/14–2017/18 cycles was conducted. Pertinent questionnaire, laboratory, dietary, and physical examination data were used to ascertain the presence of Sleep C.A.L.M. categories in adults ≥20 years of age. Nocturia was defined as ≥2 nighttime voids.

**Results:** A total of 12,274 included subjects were included (51.6% female; median age, 49.0 years [interquartile range, 34.0–62.0 years]; 27.6% nocturia). Among subjects with nocturia, the prevalence of 0, ≥1, and ≥2 Sleep C.A.L.M. categories was 3.5% (95% confidence interval [CI], 2.8%–4.4%), 96.5% (95% CI, 95.6%–97.2%), and 81.2% (95% CI, 78.9%–83.3%), respectively. Compared to those with 0–1 Sleep C.A.L.M. categories, the adjusted odds of nocturia in subjects with 2, 3, and 4–5 Sleep C.A.L.M. categories were 1.77 (95% CI, 1.43–2.21), 2.33 (1.89–2.87), and 3.49 (2.81–4.35), respectively ($P<0.001$). Similar trends were observed for most age and sex subgroups. When assessed individually, each of the 5 Sleep C.A.L.M. categories were independently associated with greater odds of nocturia, which likewise persisted across multiple age and sex subgroups.

**Conclusions:** Sleep C.A.L.M. burden is associated with increased odds of nocturia in a dose-dependent fashion, and potentially a relevant means by which to organize the underlying etiologies for nocturia among community-dwelling adults.

**Keywords:** Humans; Nocturia diagnosis; Nocturia epidemiology; Sleep; Urinary bladder; Lower urinary tract symptoms

- **Grant/Fund Support:** The United States Centers for Disease Control and Prevention and NCHS developed the database using a program approved by the NCHS Ethics Review Board and all participants provided informed consent. This study is thus exempt from local Institutional Review Board review.
- **Conflict of Interest:** No potential conflict of interest relevant to this article was reported.

## INTRODUCTION

Nocturia, defined as waking from sleep to urinate, is one of the most common lower urinary tract symptoms (LUTS) in the general population [1, 2]. Nocturia is often described as one of the most bothersome and impactful urinary symptoms, not

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only impacting a patient's quality of sleep, but also quality of life and productivity [3]. Despite the pervasiveness of nocturia, the pathogenesis of this complex condition is not completely understood, and multiple factors may play a role. Mechanistically, the onset of nocturia centers on a fundamental mismatch in the delicate balance between nocturnal urine production, bladder storage capacity, and normal sleep architecture. Importantly, such physiologic abnormalities may arise secondary to a broad range of genitourinary abnormalities as well as factors beyond the urinary tract. Unfortunately, the complex diagnostic conundrum of nocturia undoubtedly contributes to the fact that nocturia is often insufficiently evaluated and under-treated, with several shortcomings known to exist between current consensus guidelines and real-world practice [3, 4]. Recently, a memorable structure was proposed to facilitate a comprehensive clinical evaluation of nocturia in accordance with current International Continence Society (ICS) guidelines, including 5 common underlying categories: Sleep disorders, Comorbidities, Actions (i.e., modifiable patient behaviors such as excess fluid intake), Lower urinary tract dysfunction, and Medications [5]. The so-called "Sleep C.A.L.M." categories are thought to collectively reflect most underlying causes of nocturia, and thus must all be effectively diagnosed and triaged as part of initial nocturia management [6]. The purpose of this study was to assess the association of nocturia with the Sleep C.A.L.M. categories using a nationally representative dataset from the United States.

## MATERIALS AND METHODS

We conducted a retrospective review of United States National Health and Nutrition Examination Survey (NHANES) data from survey cycles 2013/14–2017/18. NHANES is a publicly available dataset without identifiers, released by the National Center for Health Statistics (NCHS), which contains cross-sectional national health survey data. The United States Centers for Disease Control and Prevention and NCHS developed the database using a program approved by the NCHS Ethics Review Board and all participants provided informed consent. This study is thus exempt from local Institutional Review Board review.

The study population included participants ≥20 years of age who completed the "Kidney Conditions-Urology" questionnaire as well as other surveys and examinations as detailed in Supplementary Table 1. Factors contributing to each category in the Sleep C.A.L.M. tool were identified using information from the "Sleep Disorders," "Prescription Medications," "Mental Health-Depression Screener," "Medical Conditions," and "Smoking-Cigarette Use" questionnaire data; "Demographic Variables and Sample Weights" data, "Glycohemoglobin" and "Biochemistry Profile" lab data, dietary data; and "Blood Pressure" physical exam data. Female subjects who indicated that they were pregnant at the time NHANES recruitment on the "Reproductive Health Questionnaire" were excluded. Nocturia was defined as a response of ≥2 to the question, "How many times do you urinate at night?". Appropriate weighing of the sample was done using the NHANES sampling strategy, as recommended by the NCHS, accounting for unequal probabilities of selection based on demographics, while adjusting for non-response and match estimates of the United States civilian noninstitutionalized population.

Subjects were grouped based on the number of Sleep C.A.L.M. categories they possessed. The Rao-Scott adjusted chi-square test was used to compare participant sex and nocturia prevalence across groups. Kruskal-Wallis tests were used to compare participant age and number of nocturnal voids across groups. Subjects were also separately grouped based on individual positive Sleep C.A.L.M. categories, wherein the Rao-Scott adjusted chi-square test and Kruskal-Wallis test were likewise used to compare categorical and continuous variables, respectively. Individual Sleep C.A.L.M. groups were not mutually exclusive.

Binary logistic regression was used to assess the impact of the number of positive Sleep C.A.L.M. categories on the odds of nocturia. Covariates included age, sex, race, and number of previous caesarean and vaginal deliveries (female subjects only). Subjects with 0–1 positive Sleep C.A.L.M. categories were predefined as the reference group. This analysis was repeated for age and sex subgroups, and separately to assess the impact of individual Sleep C.A.L.M. categories on the odds of observing nocturia. Analyses of individual Sleep C.A.L.M. categories additionally controlled for the presence of the other 4 Sleep C.A.L.M. categories. The predefined level of statistical significance was set to $P<0.05$ using a Bonferroni adjustment for multiple comparisons as warranted. All analyses were performed using IBM SPSS Statistics ver. 28.0 (IBM Co., Armonk, NY, USA).

## RESULTS

A total of 12,274 participants (51.6% female) met the criteria for inclusion (Tables 1, 2). Median subject age was 49.0 years

(interquartile range [IQR], 34.0–62.0 years). The overall weighted prevalence of nocturia was 27.6% (95% confidence interval [CI], 26.1%–29.2%). Among subjects with nocturia, the prevalence of 0, ≥1, and ≥2 Sleep C.A.L.M. categories was 3.5% (95% CI, 2.8%–4.4%), 96.5% (95% CI, 95.6%–97.2%), and 81.2% (95% CI, 78.9%–83.3%), respectively. The prevalence of nocturia in subjects with 0 positive Sleep C.A.L.M. categories was 14.2% (95% CI, 11.2%–17.8%), and the prevalence of nocturia in subjects with any positive Sleep C.A.L.M. category was 28.6% (95% CI, 27.0%–30.3%) (P<0.001 for 0 vs. ≥1 Sleep C.A.L.M. category). Nocturnal voiding burden increased in a dose-dependent fashion, from an average of 0.78 (95% CI, 0.73–0.84) for 0–1 Sleep C.A.L.M. categories to 1.66 (95% CI 1.55–1.75) for 4–5 Sleep C.A.L.M. categories (P<0.001).

On demographic subanalysis, the prevalence of nocturia was greater in females (30.1% [95% CI, 28.4%–32.0%]) compared to males (25.0% [95% CI, 23.0%–27.1%]) (P<0.001). The prevalence of nocturia was greater in subjects ≥65 years of age (44.3% [95% CI, 41.5%–47.2%]) versus subjects <65 years of age (23.3% [95% CI, 21.6%–25.0%]) (P<0.001). The prevalence of nocturia was greater in females aged <65 years (26.6% [95% CI, 24.4%–29.0%]) compared to males aged <65 years (19.9% [95% CI, 18.0%–22.0%]) (P<0.001). Conversely, in subjects aged ≥65, there was no significant difference in nocturia prevalence between females (42.6% [95% CI, 39.2%–46.0%]) compared to males (46.4% [95% CI, 42.1%–50.8%]) (P=0.145).

Overall, the odds of observing nocturia tended to increase as the number of positive Sleep C.A.L.M. categories increased (Table 3). Compared to those subjects with 0–1 positive Sleep C.A.L.M. category, the odds of observing nocturia were 1.77 (95% CI, 1.43–2.21), 2.33 (95% CI, 1.89–2.87), and 3.49 (95% CI, 2.81–4.35) for all subjects with 2, 3, and 4–5 positive Sleep C.A.L.M. categories, respectively (P<0.001). Similar trends were observed across most age and sex subgroups. Additionally, significant associations between each of the individual Sleep C.A.L.M. categories and the occurrence of nocturia were also

**Table 1.** Demographics and nocturia prevalence based on number of positive Sleep C.A.L.M. categories

| Variable | No. positive Sleep C.A.L.M. categories | | | | | |
|---|---|---|---|---|---|---|
| | 0–1 (n=4,171) | 2 (n=3,195) | 3 (n=2,829) | 4–5 (n=2,079) | Overall (n=12,274) | P-value |
| Age (yr), median (IQR) | 36.0 (27.0–50.0) | 49.0 (34.0–61.0) | 56.0 (45.0–68.0) | 61.0 (53.0–70.0) | 49.0 (34.0–62.0) | <0.001[a] |
| Sex, % female (95% CI) | 48.3 (45.9–50.7) | 46.9 (44.1–49.7) | 56.6 (53.7–59.4) | 56.1 (52.9–59.4) | 51.0 (49.7–52.3) | <0.001[b] |
| No. of nighttime voids, median (IQR) | 1.0 (0–1.0) | 1.0 (0–2.0) | 1.0 (1.0–2.0) | 1.0 (1.0–2.0) | 1.0 (0–2.0) | <0.001[a] |
| No. of nighttime voids, mean (95% CI) | 0.78 (0.73–0.84) | 1.11 (1.03–1.19) | 1.32 (1.25–1.39) | 1.66 (1.55–1.75) | 1.12 (1.08–1.6) | <0.001[a] |
| ≥2 Nocturnal voids (%) (95% CI) | 14.4 (12.6–16.3) | 26.6 (23.5–30.0) | 35.9 (32.8–39.2) | 48.3 (43.7–53.0) | 27.6 (26.1–29.2) | <0.001[b] |

All analyses weighted using the National Health and Nutrition Examination Survey sampling strategy.
Sleep C.A.L.M., Sleep disorders, Comorbidities, Actions, Lower urinary tract dysfunction, and Medications; CI, confidence interval; IQR, interquartile range.
[a]Kruskal-Wallis asymptotic significance (2-sided). [b]Rao-Scott adjusted chi-square test.

**Table 2.** Demographics and nocturia prevalence based on individual positive Sleep C.A.L.M. categories

| Variable | Individual positive Sleep C.A.L.M. categories | | | | | | |
|---|---|---|---|---|---|---|---|
| | None (n=828) | Sleep (n=5,594) | Comorbidities (n=5,735) | Actions (n=9,596) | LUTD (n=627) | Medications (n=5,165) | P-value |
| Age (yr), median (IQR) | 36 (26–49) | 54 (38–64) | 59 (48–69) | 48 (34–61) | 67 (59–76) | 60 (49–70) | <0.001[a] |
| Sex, % female (95% CI) | 67.9 (62.6–72.9) | 54.6 (52.6–56.7) | 55.3 (52.9–57.6) | 47.1 (45.7–48.6) | 23.7 (19.7–28.3) | 59.4 (57.5–61.3) | <0.001[b] |
| No. of nighttime voids, median (IQR) | 1 (0–1) | 1 (0–2) | 1 (1–2) | 1 (0–2) | 2 (1–2) | 1 (1–2) | <0.001[a] |
| No. of nighttime voids, mean (95% CI) | 0.78 (0.68–0.87) | 1.32 (1.28–1.37) | 1.41 (1.36–1.47) | 1.14 (1.36–1.47) | 1.81 (1.60–2.02) | 1.41 (1.35–1.47) | <0.001[a] |
| ≥2 Nocturnal voids (%) (95% CI) | 14.2 (11.2–17.8) | 35.1 (33.3–36.9) | 39.1 (36.6–41.8) | 28.3 (26.6–30.1) | 54.3 (46.4–62.0) | 39.1 (36.6–41.5) | <0.001[b] |

All analyses weighted using the National Health and Nutrition Examination Survey sampling strategy.
Sleep C.A.L.M., Sleep disorders, Comorbidities, Actions, Lower urinary tract dysfunction, and Medications; LUTD, lower urinary tract dysfunction; CI, confidence interval; IQR, interquartile range.
[a]Kruskal-Wallis asymptotic significance (2-sided). [b]Rao-Scott adjusted chi-square test.

**Table 3.** Adjusted odds of ≥ 2 nighttime voids based on number of positive Sleep C.A.L.M. categories

| Variable | No. positive Sleep C.A.L.M. categories | | | | |
|---|---|---|---|---|---|
| | 0–1 | 2 | 3 | 4–5 | P-value |
| All subjects | Reference | 1.77 (1.43–2.21) | 2.33 (1.89–2.87) | 3.49 (2.81–4.35) | < 0.001* |
| Male sex | Reference | 1.64 (1.18–2.27) | 2.63 (2.01–3.44) | 3.43 (2.54–4.64) | < 0.001* |
| Female sex | Reference | 1.93 (1.54–2.42) | 2.15 (1.58–2.94) | 3.55 (2.67–4.71) | < 0.001* |
| Age < 65 yr | Reference | 1.86 (1.51–2.29) | 2.31 (1.83–2.92) | 4.12 (3.21–5.29) | < 0.001* |
| Age ≥ 65 yr | Reference | 1.40 (0.87–2.25) | 2.03 (1.38–2.97) | 2.40 (1.65–3.49) | < 0.001* |
| Male age < 65 yr | Reference | 1.78 (1.28–2.47) | 2.35 (1.71–3.22) | 3.90 (2.68–5.68) | < 0.001* |
| Male age ≥ 65 yr | Reference | 1.16 (0.63–2.16) | 2.95 (1.72–5.06) | 2.63 (1.52–4.55) | 0.001* |
| Female age < 65 yr | Reference | 1.93 (1.51–2.48) | 2.33 (1.74–3.13) | 4.37 (3.13–6.10) | < 0.001* |
| Female age ≥ 65 yr | Reference | 1.66 (0.84–3.29) | 1.48 (0.79–2.77) | 2.21 (1.29–3.77) | 0.009* |

Values are presented as odds ratio (95% confidence interval).
Adjusted for age, sex, race, and number of previous caesarian and vaginal deliveries (for female subject-containing subgroups only). All results were weighted using the National Health and Nutrition Examination Survey sampling strategy.
Sleep C.A.L.M., Sleep disorders, Comorbidities, Actions, Lower urinary tract dysfunction, and Medications.
*P < 0.05, significance based on chi-square statistic with Bonferroni adjustment.

**Table 4.** Adjusted odds of ≥ 2 nighttime voids based on individual Sleep C.A.L.M. categories

| Variable | Individual positive Sleep C.A.L.M. categories | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sleep | | Comorbidities | | Actions | | LUTD | | Medications | |
| | OR (95% CI) | P-value | OR (95% CI) | P-value | OR (95% CI) | P-value | OR (95% CI) | P-value | OR (95% CI) | P-value |
| All subjects | 1.57 (1.38–1.79) | < 0.001* | 1.58 (1.37–1.82) | < 0.001* | 1.30 (1.10–1.53) | 0.002* | 2.03 (1.47–2.80) | < 0.001* | 1.24 (1.07–1.43) | 0.004* |
| Male sex | 1.64 (1.37–1.95) | < 0.001* | 1.79 (1.49–2.16) | < 0.001* | 1.12 (0.82–1.52) | 0.469 | 1.80 (1.24–2.61) | 0.002* | 1.20 (0.90–1.59) | 0.21 |
| Female sex | 1.54 (1.27–1.86) | < 0.001* | 1.45 (1.21–1.73) | < 0.001* | 1.41 (1.15–1.74) | < 0.001* | 1.90 (0.85–4.27) | 0.108 | 1.28 (1.05–1.58) | 0.014* |
| Age < 65 yr | 1.76 (1.48–2.09) | < 0.001* | 1.63 (1.39–1.92) | < 0.001* | 1.37 (1.12–1.66) | 0.001* | 1.84 (1.09–3.14) | 0.02* | 1.20 (1.00–1.45) | 0.045 |
| Age ≥ 65 yr | 1.23 (0.97–1.55) | 0.082 | 1.45 (1.10–1.91) | 0.007* | 1.19 (0.91–1.55) | 0.183 | 1.90 (1.32–2.74) | 0.001* | 1.27 (0.94–1.72) | 0.113 |
| Male age < 65 yr | 1.76 (1.40–2.20) | < 0.001* | 1.76 (1.37–2.28) | < 0.001* | 1.13 (0.77–1.66) | 0.52 | 1.54 (0.86–2.75) | 0.137 | 1.21 (0.87–1.68) | 0.254 |
| Male age ≥ 65 yr | 1.37 (0.99–1.90) | 0.054 | 1.83 (1.31–2.56) | < 0.001* | 1.08 (0.71–1.67) | 0.704 | 2.02 (1.33–3.07) | 0.001* | 1.20 (0.77–1.85) | 0.411 |
| Female age < 65 yr | 1.76 (1.38–2.24) | < 0.001* | 1.54 (1.24–1.92) | < 0.001* | 1.51 (1.18–1.92) | < 0.001* | 2.13 (0.56–8.15) | 0.257 | 1.23 (0.95–1.59) | 0.099 |
| Female age ≥ 65 yr | 1.13 (0.82–1.56) | 0.454 | 1.15 (0.76–1.74) | 0.494 | 1.25 (0.89–1.77) | 0.188 | 1.78 (0.77–4.13) | 0.165 | 1.35 (0.88–2.07) | 0.16 |

Odds of nocturia in subjects positive vs. negative for a given Sleep C.A.L.M. category. Adjusted for age, sex, race, and number of previous caesarian, and vaginal deliveries (for female-containing subgroups only), as well as positive/negative status of other Sleep C.A.L.M. categories. All results were weighted using the National Health and Nutrition Examination Survey sampling strategy.
Sleep C.A.L.M., Sleep disorders, Comorbidities, Actions, Lower urinary tract dysfunction, and Medications; LUTD, lower urinary tract dysfunction; OR, odds ratio; CI, confidence interval.
*P < 0.05, significance based on chi-square statistic with Bonferroni adjustment.

observed, which likewise persisted on multiple subgroup analyses (Table 4).

## DISCUSSION

The present study findings demonstrate the 5 Sleep C.A.L.M. categories are positively associated with nocturia. Furthermore, there appears to be a dose-dependent relationship between Sleep C.A.L.M. burden and odds of nocturia, which persists across multiple sex and age subgroups. Taken together, the present study findings of Sleep C.A.L.M. in a nationally representative United States database suggest that the Sleep C.A.L.M. categories may be a relevant means by which to organize the potential underlying etiologies for nocturia.

The above-mentioned findings of significant positive associations between Sleep C.A.L.M. categories and nocturia held true

across most individual subgroup analyses and across individual Sleep C.A.L.M. categories, even when accounting for age, sex, race, and number of previous deliveries. Age is often described as a robust correlate of nocturia [7]. The Sleep C.A.L.M. categories likely contribute to a large part of this association, as many relevant diagnoses and contributory factors which comprise the Sleep C.A.L.M. categories also increase in prevalence with age [5]. Interestingly, however, the strength of the association between nocturia and the presence and number of Sleep C.A.L.M. categories tended to be more pronounced in younger vs. older adults, which underscores the need for greater understanding of the complex relationship between nocturia, Sleep C.A.L.M., and processes of normative aging.

The present study results are consistent with a growing body of literature demonstrating robust associations between nocturia and the individual factors and diagnoses which comprise the Sleep C.A.L.M. categories. Sleep disorders are inextricably linked to nocturia, as nocturia has been cited as the most common cause of disturbed sleep among older adults in multiple population surveys on sleep quality and insomnia, while nocturnal voiding episodes are a frequent co-occurrence of awakenings precipitated by factors other than a sensation of bladder fullness (e.g., so-called "convenience voids" in patients with primary sleep disorders) [8]. To this end, the relationship between nocturia and disordered sleep is increasingly recognized as highly intertwined and often bidirectional [9]. Consistently, disordered sleep provides an excellent illustration of the extent to which even a single Sleep C.A.L.M. category may have multifactorial consequences on the fundamental balance between nocturnal urine production, bladder storage capacity, and normal sleep architecture which determine nocturia presence and severity [10]. Sleep apnea, for example, has been well described to promote excess nocturnal urine production via pulmonary vasoconstriction-induced right heart strain and resultant natriuretic peptide release, and may also promote detrusor muscle instability and decreased compliance — both of which tipping the scale toward a scenario in which bladder urine volume exceeds nocturnal capacity and the patient must awaken to urinate [11, 12].

Beyond sleep disorders, there also exists an ever-increasing body of literature underscoring the intricate relationship between nocturia and the other Sleep C.A.L.M. categories. Nocturia has been recognized as a hallmark of several serious medical conditions beyond the genitourinary tract — particularly in the context of cardiovascular conditions, as nocturia is not only pervasive among those with overt cardiovascular disease, but also a clinically relevant predictor of early or undiagnosed disease and marker of treatment response [13, 14]. Modifiable risk factors that have been found associated with nocturia include obesity, excess fluid intake, dietary sodium and caffeine, and the use of alcohol [15-18]. While population level evidence between nocturia and these commonly implicated behaviors remains inconsistent (likely owing to unclear causality, with those subjects with nocturia potentially more likely to self-treat with dietary modifications), these factors are well supported as relevant to nocturia by well-controlled physiology trials, and current must be carefully evaluated in the clinical management of nocturia according to current consensus guidelines from the ICS [6, 19, 20]. As is inherent to the concept of Sleep C.A.L.M., nocturia may indeed exist in the absence of identifiable genitourinary abnormalities and associated LUTS, but nevertheless remains pervasive in the context of common urologic conditions — more common in men with prostatic obstruction compared to their contemporary counterparts, and present in up to 85% of participants in pivotal overactive bladder syndrome trials [21]. Just as several systemic conditions have been associated with nocturia, so too are many common medications used in their treatment, which may adversely promote excess nocturnal urine production, directly affect the bladder, or conceivably lower the threshold at which bladder afferent signaling is sufficient to overcome the mechanisms maintaining sleep via alterations in sleep architecture [5].

The present study findings must be interpreted in view of several important limitations. A wide array of questionnaire, dietary, lab, and physical exam data was used in establishing Sleep C.A.L.M. categorization. The inherent limitations of a retrospective analysis preclude assessment of causality between any given factor and a subject's nocturia, which carries the potential for significant overdetection of contributory Sleep C.A.L.M. categories. By the same token, reliance on questionnaire data to establish much of a subject's pertinent medical history also fails to capture undiagnosed medical illness. Among those with diagnosed medical illness, the present study was limited in its ability to quantify disease severity, chronicity, or medication dosage. Additionally, the absence of voiding diary data precluded better characterization of the mechanism(s) by which individual Sleep C.A.L.M. categories and their constituent contributory factors specifically promoted increased nocturnal voiding frequency.

In conclusion, the cumulative burden of Sleep C.A.L.M. fac-

tors, in addition to each factor individually, is associated with increased odds of nocturia. These findings hold true across multiple age and sex subgroups. Sleep C.A.L.M. is seemingly a relevant means by which to organize the potential underlying etiologies for nocturia; further research incorporating real-world study patients and voiding diary data are warranted.

## SUPPLEMENTARY MATERIAL

Supplementary Table 1 can be found via https://doi.org/10.5213/inj.2346258.129.

### AUTHOR CONTRIBUTION STATEMENT

- Conceptualization: *JUB, BDL, LK, MDC, SNR, JML, JPW, TFM*
- Data curation: *JUB, BDL, LK, MDC*
- Formal analysis: *JUB, BDL, LK, MDC, SNR, JML, JPW, TFM*
- Methodology: *JUB, BDL, LK, MDC, SNR, JML, JPW, TFM*
- Project administration: *JUB, BDL, SNR, JML, JPW, TFM*
- Visualization: *JUB, BDL, LK, MDC, JML, JPW, TFM*
- Writing - original draft: *JUB, BDL, LK, MDC, JML, JPW, TFM*
- Writing - review & editing: *JUB, BDL, LK, SNR, JML, JPW, TFM*

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