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# Potentially avoidable interfacility transfers following reduced emergency department volumes due to COVID-19 “Safer-at-Home” orders

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## ABSTRACT

**Objectives:** We sought to assess if a state-wide lockdown implemented due to COVID-19 was associated with increased odds of being a potentially avoidable transfer (PAT).

**Methods:** We conducted a retrospective observational analysis using hospital administrative data of interfacility ED-to-ED transfers to a single, quaternary care adult ED after “Safer at Home” orders were issued March 23rd, 2020 in [Blinded for submission]. Using the PAT classification to identify transfers rapidly discharged from the ED or hospital and may not require in-person care, we used a multivariable logistic regression model to examine the association of the lockdown order with odds of a transfer being a PAT. We compared the period January 1, 2018 to March 23, 2020 with March 24, 2020 to September 30, 2020, adjusting for seasonality, patient, and situational factors.

**Results:** There were 20,978 ED-to-ED transfers from during this period that were eligible and 4806 (23%) that met PAT criteria. While the first month post-lockdown saw a decrease in PATs (28%), this was not sustained. In the multivariable model there was a significant seasonal effect; May through September had the highest number of transfers as well as PATs. After adjusting for seasonality, the lockdown was not associated with PATs (adjusted odds ratio [aOR] 0.99, 95% CI 0.2, 5.2) and PATs decreased over time.

**Conclusions:** We did not find an effect of the COVID-19 lockdown on PATs though there was a considerable seasonal effect and an overall downward trend in PATs over time.

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## 1. Introduction

Emergent interfacility transfers occur as a means to access specialty care but can be disruptive to patients, families, and staff [1]. There is wide variability in the practices of transferring facilities. The Agency for Healthcare Research and Quality's (AHRQ) HCUPNet, estimates that in 2016 there were nearly 2.3 million ED transfers and the number of transfers has nearly doubled since 2006 [2]. While transfers enable patients to access specialty care that otherwise might not be available to them, they are also associated with increased length of stay, costs, and inpatient mortality, even after adjusting for patient characteristics

and mortality risk [3]. They also can result in a significant disruption into ED workflows and operations [1,4].

Prior work from [Blinded] and others demonstrated nearly 1-in-4, may be “potentially avoidable” because they are rapidly discharged from the ED or the hospital (if admitted) [4–6]. Called “potentially avoidable transfers” (PATs), such transfers are defined as either discharged from the ED, or admitted for <24 h without a specialty procedure. Such transfers may be amenable to alternative means of care (e.g., telehealth), obviating the need for physical transfer and easing the burden on already crowded EDs [7]. A systematic review of telehealth for neurosurgical patients, focused specifically on neurotrauma and emergent neurological conditions, suggested that the use of telemedicine in emergent settings facilitated safe and feasible methods of increasing access to neurosurgical care [8].

The COVID-19 pandemic substantially impacted U.S. healthcare. Some studies found a nearly 42% reduction in ED visits when comparing

Abbreviations: CI, Confidence Interval; PAT, potentially avoidable transfer.

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volumes early in the pandemic to the same time period a year earlier [9,10].

While prior work demonstrated reduced emergency transfer volume for patients with acute stroke and trauma during the pandemic, the broader impact on general ED-to-ED interfacility transfers, specifically in the US, is not known [11–13]. Further, cognitive psychology suggests that stress may adversely affect decision-making [14]. Lower workload is associated with improved decision-making when prescribing opioids and admitting [15,16]. Locally, during the pandemic we identified that ED stroke activations were more likely to be diagnosed with acute ischemic stroke. Thus, we sought to examine the COVID-19 pandemic as a system stressor rather than disease-focused and to examine all interfacility ED-to-ED transfers during this pandemic period. We hypothesized that the proportion of transfers meeting the PAT definition would be reduced given the lower ED volumes and overall stress imposed on external EDs.

## 2. Methods

We conducted a retrospective observational analysis using hospital electronic administrative data of all interfacility transfers to a single quaternary care facility's ED – [Blinded for manuscript submission]. XXX is a major receiving center in [Region]–the region's only Level 1 trauma center with a catchment of approximately 65,000 mile<sup>2</sup>. To examine broader trends in interfacility transfers, we included transfers that occurred between January 1, 2018 and September 30, 2020. Time periods prior to January 2018 were excluded as a new electronic health record was implemented during this time, replacing the software previously used by our facility.

Our timeframe for analysis included the period before and after Safer-at-Home orders were issued by the XXX Health Department on March 23, 2020, restricting the movement and activities of people in XXX to reduce the spread of COVID-19 [17]. We used the time leading up to the issuance of the Safer-at-Home order to establish the baseline in transfer patterns and trends. These orders ran through the end of the study period when the mandate officially expired and a majority of surrounding counties re-opened (not including the county of the receiving hospital). For reference, Lockdown for all counties in the state continued until April 30th when 89/95 counties re-opened with advancement plans. COVID-19 daily new cases in the state over the lockdown remained low at an average of 271 per day [18].

Our primary outcome was an ED-to-ED interfacility transfer that met the PAT definition; either discharged from the ED or an inpatient/observation length of stay <24 h without a specialty procedure [4,6]. Our key independent variable was the time period, classified as before the COVID-19 Stay-at-Home order versus after the order. We constructed a multivariable logistic regression model to examine whether this lockdown period was associated with increased odds of transfers being a PAT [5]. Covariates included seasonality, duration of time since start of the study, patient factors and facility characteristics. Patient factors included demographics (age, sex, insurance, race), situational (arrival during the week, arrival during non-business hours, mode of arrival, acuity at arrival) and clinical diagnostic group as determined by AHRQ's Clinical Classification Software (CCS) [2]. Facility characteristics included transferring hospital type (urban versus rural).

Our objective was to assess if transfers during the lockdown had higher odds of being a PAT. We sought to examine COVID-19 as a system stressor (one which dramatically affected ED volumes) and how this decline in patients affected PATs. To ensure preservation of all observations we applied a single value imputation using the mode for all independent variables as necessary. Since all patients are eligible for Medicare at age 65, we planned to include an interaction term between age and insurance status. We sought to obtain 6 months of data after the shutdown to capture immediate trends. This timeframe was used as a common timeframe to evaluate the sustainability of an intervention. Electronic data abstraction was conducted by a study team member

who was aware of the intended study outcomes but did not conduct the analyses.

## 3. Results

From the original review of our EHR in January 1, 2018 through September 30, 2020, we identified 187,000 ED visits. After applying our inclusion/exclusion criteria, we identified 20,978 transfers during our study period that met eligibility criteria. Among these, 3,906 (18.6%) occurred after the Safer-at-Home order. A CONSORT diagram of our study population can be seen in Fig. 1.

As seen in Table 1, our study population was more likely to be white males over 65 and have Medicare as their primary insurer. Patients were most likely to arrive during non-business hours via ground ambulance. Among PATs, transfers were younger (median age of 46, interquartile range [IQR] 31.5, 61.8) years compared with non-PATs (58.7 years, [IQR] 43.3, 70.8) and were more likely to be uninsured (20.2% vs. 9%). Among transferred patients, the three most common diagnostic groups were for injury codes and these transfers accounted for a higher proportion of PATs vs. non-PATs (49% vs. 31%). In the 7 months post-lockdown, there was an overall downward trend in the number of PATs. However, this trend was a continuation of the period between 2018 and 2020. Additionally, over these three years, the top five referring facilities (by number of transfers) consistently maintained PAT rates between 27% and 32% – higher than the median.

After accounting for seasonality in our multivariable analysis, the likelihood of a transfer being a PAT did not change after lockdown (adjusted odds ratio 1.0, 95%CI 0.2, 5.2). While the proportion of all PATs was decreasing prior to the lockdown, we did not see a change in the likelihood of being a PAT. The remainder of covariates are in a Forest Plot (Fig. 2). The following factors were associated with higher odds of being a PAT: lack of insurance (vs. commercial insurance) and arrival during non-business hours. The following factors were associated with lower odds of being a PAT: female sex, increasing age (for

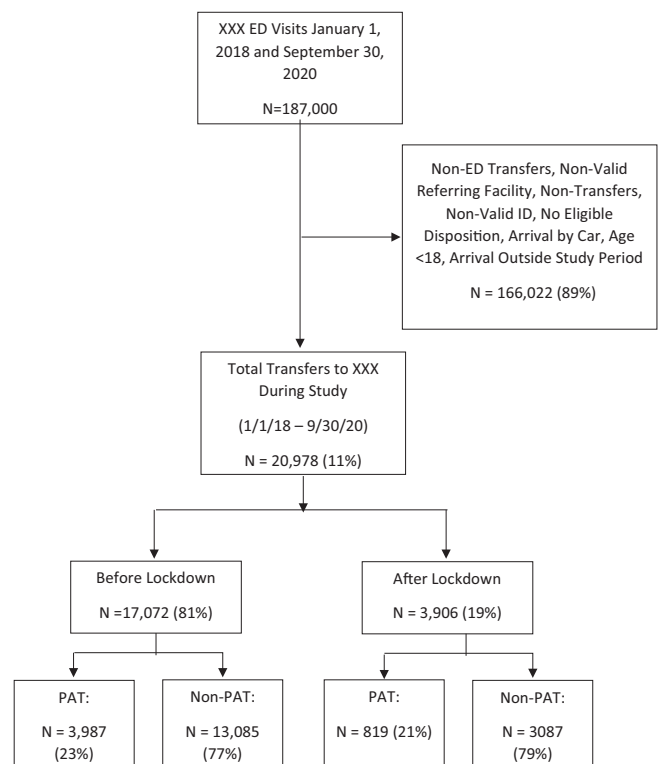
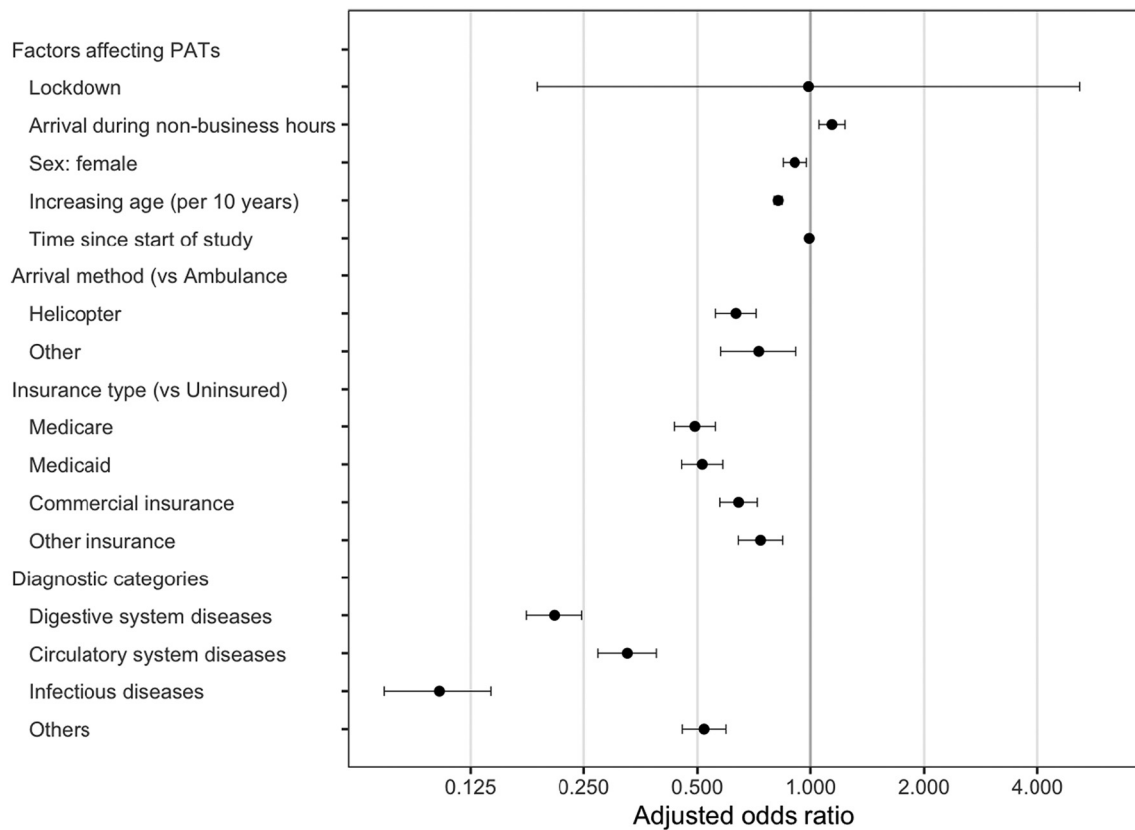


Fig. 1. CONSORT Diagram of patient cohort definition.

**Table 1**  
Patient Characteristics from Interfacility Transfers by Potentially Avoidable Transfer (PAT) status.

Variable		Overall N = 20,978	Before Lockdown N = 17,072	After Lockdown N = 3906	Difference (95% CI)
<b>PAT (%)</b>	Non-PAT	16,172 (77.1)	13,085 (76.6)	3087 (79.0)	−0.02 (−0.04, −0.01) <sup>b</sup>
	PAT	4806 (22.9)	3987 (23.4)	819 (21.0)	0.02 (0.01, 0.04) <sup>b</sup>
<b>Age (median [IQR])</b>		56.3 [39.7, 69.2]	56.4 [39.9, 69.5]	55.9 [39.1, 68.2]	0.95 (0.27, 1.63) <sup>a</sup>
<b>Sex (%)</b>	Male	11,844 (56.5)	9553 (56.0)	2291 (58.7)	−0.03 (−0.04, −0.01) <sup>b</sup>
	Female	9134 (43.5)	7519 (44.0)	1615 (41.3)	0.03 (0.01, 0.04) <sup>b</sup>
<b>Race Group (%)</b>	White	17,285 (82.4)	14,130 (82.8)	3155 (80.8)	0.02 (0.01, 0.03) <sup>b</sup>
	African American	2727 (13.0)	2222 (13.0)	505 (12.9)	0 (−0.01, 0.01) <sup>b</sup>
	Other	966 (4.6)	720 (4.2)	246 (6.3)	−0.02 (−0.03, −0.01) <sup>b</sup>
<b>Point of Origin (%)</b>	Hospital (Acute Care Facility)	17,227 (82.1)	13,649 (79.9)	3578 (91.6)	−0.12 (−0.13, −0.11) <sup>b</sup>
	Non-Healthcare Facility	3751 (17.9)	3423 (20.1)	328 (8.4)	0.12 (0.11, 0.13) <sup>b</sup>
<b>Insurance Coverage (%)</b>	Insured	18,558 (88.5)	15,190 (89.0)	3368 (86.2)	0.03 (0.02, 0.04) <sup>b</sup>
	Uninsured	2420 (11.5)	1882 (11.0)	538 (13.8)	−0.03 (−0.04, −0.02) <sup>b</sup>
<b>Mode of Transport (%)</b>	Ambulance	17,608 (83.9)	14,409 (84.4)	3199 (81.9)	0.03 (0.01, 0.04) <sup>b</sup>
	Medical Flight	2657 (12.7)	2079 (12.2)	578 (14.8)	−0.03 (−0.04, −0.01) <sup>b</sup>
	Other	606 (2.9)	535 (3.1)	71 (1.8)	0.01 (0.01, 0.02) <sup>b</sup>
	NA	107 (0.5)	49 (0.3)	58 (1.5)	
<b>Patient Stability (%)</b>	Systolic BP ≥ 90 mmHg	13,474 (64.2)	13,474 (78.9)	0 (0.0)	0.79 (0.78, 0.8) <sup>b</sup>
	Systolic BP < 90 mmHg	269 (1.3)	269 (1.6)	0 (0.0)	0.02 (0.01, 0.02) <sup>b</sup>
	Unknown	7235 (34.5)	3329 (19.5)	3906 (100.0)	
<b>Transferring Hospital Type (%)</b>	Urban	10,644 (50.7)	8736 (51.2)	1908 (48.8)	0.02 (0.01, 0.04) <sup>b</sup>
	Rural	10,334 (49.3)	8336 (48.8)	1998 (51.2)	−0.02 (−0.04, −0.01) <sup>b</sup>
<b>Travel Distance (median [IQR])</b>		59.0 [32.0, 95.0]	59.0 [32.0, 93.0]	65.0 [32.0, 101.0]	0 (−4, 0) <sup>a</sup>
<b>Business Hour (%)</b>	Business Hours	6049 (28.8)	4982 (29.2)	1067 (27.3)	0.02 (0, 0.03) <sup>b</sup>
	Non-Business Hours	14,929 (71.2)	12,090 (70.8)	2839 (72.7)	−0.02 (−0.03, 0) <sup>b</sup>
<b>Acuity, collapsed (%)</b>	1-Immediate	526 (2.5)	419 (2.5)	107 (2.7)	0 (−0.01, 0) <sup>b</sup>
	2-Emergent	8577 (40.9)	7053 (41.3)	1524 (39.0)	0.02 (0.01, 0.04) <sup>b</sup>
	3–5 Urgent to Non-Urgent	11,784 (56.2)	9526 (55.8)	2258 (57.8)	0.56 (0.55, 0.57) <sup>b</sup>
	Unknown	91 (0.4)	74 (0.4)	17 (0.4)	0 (0, 0) <sup>b</sup>
<b>CCS Categories (%)</b>	Symptoms, Not Classified	1522 (7.3)	1242 (7.3)	280 (7.2)	0 (−0.01, 0.01) <sup>b</sup>
	Injury	7307 (34.8)	5778 (33.8)	1529 (39.1)	−0.05 (−0.07, −0.04) <sup>b</sup>
	Digestive	2653 (12.6)	2229 (13.1)	424 (10.9)	0.02 (0.01, 0.03) <sup>b</sup>
	Circulatory	2530 (12.1)	2071 (12.1)	459 (11.8)	0 (−0.01, 0.02) <sup>b</sup>
	Others	4926 (23.5)	4017 (23.5)	909 (23.3)	0 (−0.01, 0.02) <sup>b</sup>
<b>ED Disposition Status (%)</b>	Discharge	3588 (17.1)	2995 (17.5)	593 (15.2)	0.02 (0.01, 0.04) <sup>b</sup>
	Admit	17,051 (81.3)	13,822 (81.0)	3229 (82.7)	−0.02 (−0.03, 0) <sup>b</sup>
	Other	339 (1.6)	255 (1.5)	84 (2.2)	−0.01 (−0.01, 0) <sup>b</sup>
<b>Specialty Procedure (%)</b>	No	15,234 (72.6)	12,473 (73.1)	2761 (70.7)	0.02 (0.01, 0.04) <sup>b</sup>
	Yes	5744 (27.4)	4599 (26.9)	1145 (29.3)	−0.02 (−0.04, −0.01) <sup>b</sup>

<sup>a</sup> Wilcoxon.<sup>b</sup> Risk difference.



**Fig. 2.** Association of facility and patient characteristics with an ED-to-ED transfer meeting criteria for PAT. Adjusted odds ratios (95% CI) in this forest plot were generated from a single multivariable logistic regression model with each variable displayed included as an independent variable in the model. Factors falling to the RIGHT of the line are associated with increased odds, those falling to the left with decreased odds.

every 10 years), specific diagnostic codes (digestive, infectious, or circulatory conditions), and arrival by means other than ambulance (e.g., helicopter). Of note, there was no effect when we included an age by insurance interaction term to our model.

Regarding the seasonal effect where we might account for periods of time with an expected increase or decrease in transfers (e.g., trauma season), there was still a relative decreasing trend in the number of PATs. This is consistent with changes seen before and continuing after the period of interest (Fig. 3). Thus, as time went on, the odds of being a PAT decreased, despite the lockdown.

#### 4. Discussion

When examining ED-to-ED interfacility transfers into [City], we found no difference in the likelihood of a transfer being a PATs pre- and post-COVID-19 lockdown. This work makes the following three important contributions: First, the likelihood of these transfers meeting the PAT criteria did not appear affected by the lockdown order, despite the significant declines in overall ED volume. Second, we identified an overall downward trend in PATs that began well before COVID-19. Third, we examine the broader emergency transfer trends in a large catchment area in the Southeast where we identified a significant impact of seasonality on transfer patterns; future work may be warranted to better understand the root cause of such seasonal fluctuations.

Our findings suggest that the issuance of a lockdown order in the [City], in the setting of broader reduction in ED volumes, did not substantially impact transfer patterns. We suspect that this can be partially explained by the relative brevity of adherence to the lockdown order. Further, the lockdown order was applicable to [City], but other counties either did not have such an order or allowed theirs to expire after only

one month [19,20]. Of note, uninsured patients were much more likely to be PATs but Medicaid patients were the least likely to be PATs among insured individuals. Medicaid patients are likely to have more comorbidities [21], may be sicker, and therefore have lower odds of being a PAT.

While we use the PAT criteria to identify transfers potentially amenable to alternative forms of care, this definition does not address the appropriateness of these transfers. Events surrounding the transfers themselves, such as the availability of resources and patient and/or clinician preferences at the time of transfer, are unknown. The use of the PAT criteria facilitates the retrospective identification of transfers that may be amenable to other effective means of care (e.g., telehealth) [22–26].

Interestingly, we found that PATs appeared to be decreasing prior to the start of the COVID-19 pandemic and with significant seasonal effects. While we reasoned that the overall decline in ED volumes during the COVID-19 pandemic [9,27] may affect the availability of specialty consultation at referring sites, the decline in PATs began before COVID-19 and was not sustainably affected by the lockdown. We also see that season (i.e. summer months with increased trauma) did significantly affect PATs and that nearly 30% of all transfers and PATs in 2018–2020 occurred from 5 referring institutions, suggesting that telehealth could be targeted [22,25,26].

#### 5. Limitations

This is a retrospective observational design, and the use of the PAT criteria may not reflect the clinical complexity, patient preferences, or immediate availability of the resources involved in the decision-making at transfer. What may be classified as “potentially avoidable”

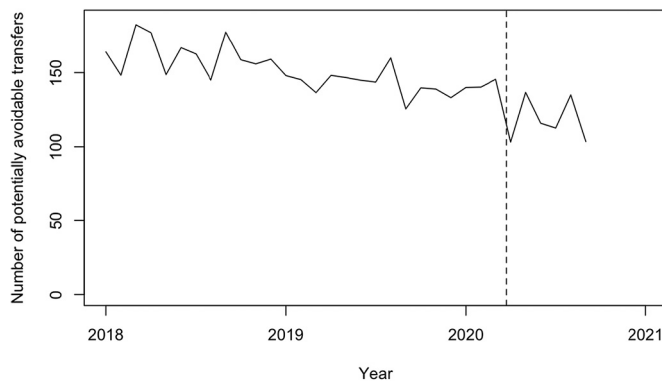


Fig. 3. Seasonally adjusted number of PATs per month.

may be an entirely appropriate decision within the context in which the transfer decision was made. However, this framework for looking at transfers has been used elsewhere [5] and provides an opportunity to evaluate what happens with transfers and where there may be opportunities for intervention given the disruptive and costly nature of transfers. In addition, we chose to use arrival emergency severity index (ESI) at the receiving facility as a surrogate of clinical severity and indicator of the severity seen by the receiving hospital. This is considered a limitation as we may have been seeing patients that were resuscitated at their index presentation and, while ultimately a PAT, were completely appropriate transfers. Additionally, this is a relatively limited sample of PATs, as evidenced by the wide confidence interval for lockdown in Fig. 2. A larger sample size would reduce the uncertainty and better define the association with PATs.

Last, this work was limited to a single quaternary care facility in the Southeast and may not reflect the patient population nor transfer practices and occurrence of COVID-19 mitigation efforts that happened in other regions, potentially limiting its generalizability.

## 6. Conclusions

The likelihood of being a PAT before and after a COVID-19 lockdown was unchanged. However, we identified significant seasonality in ED-to-ED interfacility transfers and a longitudinal reduction in PATs unrelated to the COVID-19 lockdown.

Note: “Seasonally adjusted” refers to the removal of patterns which repeat with a fixed period. The dashed line represents COVID-19 lockdown orders issued on March 23, 2020.

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## CRedit authorship contribution statement

**Graham Van Schaik:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Wesley H. Self:** Writing – review & editing, Supervision, Resources, Methodology, Conceptualization. **Cassandra Hennessy:** Writing – review & editing, Validation, Methodology, Investigation, Formal analysis, Data curation. **Michael J. Ward:** Writing – review & editing, Writing – original draft,

Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

## Declaration of Competing Interest

None.

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