The Journal of Climate Change and Health 24 (2025) 100478

Contents lists available at ScienceDirect

The Journal of Climate Change and Health

journal homepage: www.elsevier.com/joclim

Short communication

Implementation of a heat alert system for clinical staff in an ambulatory setting: A pilot project

Paul F Dellaripa [a,*], Candace Feldman [a], Lydia Gedmintas [a], Susan Ritter [a], Caleb Dresser [b]

[a] Department of Rheumatology, Brigham and Women's Hospital, USA
[b] Department of Emergency Medicine, Beth Israel Deaconess Medical Center, Department of Environmental Health, Harvard T.H. Chan School of Public Health, USA

ARTICLE INFO

Key Words:
Heat
Counseling
Climate change
Early warning systems

ABSTRACT

Introduction: Climate change leads to an increasing risk of heat exposure and pre-emptive alerting to patients may be an important intervention to limit health risks related to heat. The process of providing counseling and resources related to impending dangerous heat in an ambulatory clinic setting has not been described. In this pilot project utilizing an electronic heat alert system, we describe the implementation of a clinic-level protocol for providing alert-based heat health information and proactively educating rheumatology patients in an ambulatory setting on dangerous heat conditions.

Methods: Physicians, nurses and medical assistants received electronic notifications of dangerous heat forecasts via a external heat alert system (Realtime Climate Heat Risk). Participating staff completed surveys at the midpoint and end of the heat season. The primary endpoint was a self-reported estimate of the percentage of patients engaged regarding heat safety on days where heat alerts were issued.

Results: There were 4 heat alert days during the study period. Half of participating staff members reported they had engaged 50 % or more of their patients on this topic. Self-reported levels of engagement by medical assistants were significantly higher than those of physicians and nurses, ($W = 4.5$, p-value $= 0.036$).

Conclusions: Heat and other environmental exposures present risks to patients as the effects of climate change worsen. Heat alerts may help staff address health risks with their patients. This pilot study demonstrates that an external heat alert system can be implemented utilizing providers of different skill levels and at all points of patient interaction in an ambulatory clinic setting.

1. Introduction

Climate change is leading to hotter summers and increasing exposure of patients to dangerous heat [1,2]. Since the 1960s, the frequency of heat waves in American cities has more than doubled, and the duration of the season in which heat waves occur has lengthened substantially [3]. Future warming is expected to lead to further increases in the occurrence of dangerous heat conditions, which may range from limited to extreme increases in heat exposure depending on the degree to which greenhouse gas emissions are reduced in coming years [2].

Heat exposure has been linked with numerous health impacts, including increases in all-cause mortality, reproductive health issues, and presentations for heat stroke and a wide variety of other conditions in outpatient and emergency settings [1,4]. Certain patient populations are at particularly high risk during hot conditions, including those with underlying medical fragility, those taking certain medications including those for cardiovascular and psychiatric disease, those who are pregnant or elderly, those who reside in urban heat islands, lack access to air conditioning or other cooling, or who work outdoors in hot conditions [1,4,5]. Patients with rheumatologic disease are at increased risk for adverse health outcomes due to heat exposure related to the systemic nature of their disease including renal, pulmonary and cardiac morbidities [6,7].

Heat alerts have been issued to populations at regional scales in a variety of settings, but evidence of their efficacy is mixed, with some large-scale studies finding little or no effect on health outcomes [8,9]. It is theorized that general heat warnings may be ignored, missed, or impracticable to act on for some at risk individuals, raising the question of whether a more targeted approach combined with referrals to resources may be more effective. Clinicians have opportunities to counsel and provide resource referrals to individual patients, particularly those believed to be at high risk during hot weather, but data on operationalization of this approach is lacking.

In this pilot study utilizing an electronic heat alert system, we describe the implementation of a clinic-level protocol for accessing and using alert-based heat health information and proactively educating rheumatology patients in an ambulatory setting on dangerous heat conditions and actions to protect their health.

*Correspondence author at. Brigham and Women's Hospital, 60 Fenwood Rd, Boston MA 02115, USA.
E-mail address: pdellaripa@bwh.harvard.edu (P.F. Dellaripa).

https://doi.org/10.1016/j.joclim.2025.100478
Received 29 October 2024; Accepted 9 June 2025

2. Methods

2.1. Study setting and heat alert system

Rheumatology clinic staff consisting of physicians, nurses, and medical assistants in an academic urban outpatient clinic setting received electronic alerts via an external heat alert system regarding impending heat that was expected to be dangerous to human health. Heat alerts were received via email (Supplement 1) from the Climate Central Real-time Climate Heat Risk system [10], which provides clinicians with location-specific alerts on anticipated dangerous heat conditions over the next five days, based on data from the US CDC / NOAA Heat Risk tool [11–13]. These alerts included information on how dangerous the heat was expected to be over each of the next five days, based on historical epidemiological data, and provided information on populations at risk and links to resources for education and counseling, including the Harvard / Americares Climate Resilience for Frontline Clinics Toolkit [14] and heat health resources from the US CDC [15].

Heat Risk levels were graded as moderate, major or extreme. We informed clinical staff to communicate heat risk to patients (using standardized script supplement 2) on days that were predicted to reach major or extreme heat risk. All clinic staff participants were then asked to engage patients at the time the alert was received and during the heat wave, either in person or using online communication, re-iterating this warning and offering action-oriented recommendations via the toolkit tip sheets (https://www.americares.org/wp-content/uploads/Extreme Heat_ActionPlanTipSheet_Final.pdf) on adequate hydration, heat avoidance, use of air conditioning or cooling centers [14].

2.2. Patient engagement

Patients were engaged during regularly scheduled visits or other routine remote interactions. No targeted outreach was implemented. Physicians interacted with patients in person in clinic or online via telehealth or messaging in the electronic patient portal. Medical assistants interacted with patients in person during intake of patients for an ambulatory visit. Nurses interacted with patients via the electronic patient portal responding to patients' clinical questions related to their care.

A standardized script with instructions was created to facilitate interaction with patients (Supplement 2). This script consisted of specific steps for clinical staff which included informing the patient of the dangerous heat conditions, counseling on specific actions to avoid heat illness, and offering information on resources to limit heat exposure (such as cooling centers)

A dot phrase was created and shared via email to all participants to be used in the electronic health record to facilitate documentation of discussions and counseling. (Supplement 2)

2.3. Assessment

A survey (Supplement 3) was administered to all clinical staff at the midpoint and at the end of the project. Respondents provided an estimate of the percentage of their patients that they engaged on the topic of heat (primary endpoint), as well as) comments and feedback on the intervention, including use of the dot phrase and distribution of informational materials. Analysis was limited to descriptive statistics given the small sample size in this pilot implementation. Wilcoxon rank sum test was used to assess differences in engagement between different categories of clinical staff. The Mass General Brigham Institutional Review Board determined this project did not constitute human subjects research (ID #1933).

3. Results

3.1. Participants

Twelve members of the clinic staff, including four physicians, three nurses, and five medical assistants agreed to participate in the pilot project. During the implementation period in the summer of 2024 (June 14-July 26), there were a total of four days of major or greater heat risk at the clinic location (June 18 and 20; July 15 and 16). Total number of clinic patients amongst participating clinicians (physicians, nurses and medical assistants) that could be engaged on those 4 days was 427. Of the original participant cohort, 2 out of 3 nurses, 5 of 5 medical assistants, and 4 of 4 physicians participated in implementation of the pilot project. The staff survey was conducted between June 26-July 26.

3.2. Engagement

The primary question posted in the staff survey at the end of the project asked participants to estimate the percentage of their patients whom they informed about heat risks and actions they could take to reduce their health risks on days for which heat alerts were issued. Of the 12 initial participants in the study, 3 reported engaging >80 % of their patients on the topic of heat, 3 reported engaging 50 % to 80 % of their patients on the topic of heat, and 4 reported engaging between 20 % and 50 % of their patients on the topic of heat; one participant engaged <10 % of their patients, and 1 nurse ultimately chose not to participate in the implementation at all.

The level of engagement varied between professional roles. More than half of the medical assistants reported engaging >80 % of their patients, while none of the physicians reported engaging >80 % of their patients, and none of the nurses reported engaging >50 % of their patients. The self-reported levels of engagement by medical assistants were higher than those of physicians and nurses, a difference that was statistically significant at alpha = 0.05 by the Wilcoxon Rank Sum test (W = 4.5, p-value = 0.036). The distribution of self-reported patient engagement rates by profession is presented in Table 1.

Of the 12 participants, 1 reported using the electronic health record dot phrases that were provided to support their documentation. Additional comments by physicians, nurses and medical assistants on the staff survey included challenges due to time constraints, appropriate level of detail to provide to patient, and whether to assess patients for higher risk for heat illness.

4. Discussion

4.1. Discussion

As global temperatures rise and the health impacts of heat escalate, clinicians and healthcare organizations are increasingly seeking means to prevent heat from affecting the health of their patients. Possible approaches include early warning systems through healthcare systems applications, educational programs, community-based prevention initiatives, and programs that distribute air conditioners or offer access to cooling centers, each of which needs to be implemented and assessed under real-world conditions across a variety of settings. Evidence of the effectiveness of population-level heat warnings has been mixed [8,9]. The feasibility and effectiveness of clinic-oriented warning systems that can inform a more targeted approach towards at-risk patients are unknown to this point.

Table 1
Distribution of patient engagement rates for physicians, nurses, and medical assistants on the topic of heat safety when at least Major heat alerts were received.

Respondent Type	Percentage of Patients Engaged			
	>80 %	50 % to 80 %	20 % to 50 %	<10 % or staff withdrew
Physicians	–	2	2	–
Nurses	–	–	–	2
Medical Assistants	3	1	1	–

In this pilot project, we demonstrate the feasibility of implementing a clinic-based heat safety assessment and counseling program informed by external heat alerts and resources; efficacy of this intervention was not assessed. Self-reported patient engagement rates in this study suggest that a substantial proportion of the patients served by participating staff were assessed and received information related to health protection during dangerously hot weather; half of participating staff members reported they had engaged 50 % or more of their patients on this topic.

Medical assistants reported the highest levels of participation in terms of the percentage of ambulatory patients whom they engaged on the topic of heat-related health risks. Nurses and physicians reported engaging a lower proportion of their patients. Factors affecting reported levels of engagement were not formally assessed but comments received included limits due to time constraints and challenges integrating heat counseling into the flow of care for patient visits as the most common concerns.

Advice and resources on heat were offered to any patient without consideration for specific level of risk for morbidity related to heat exposure. Rheumatology patients in general are at elevated risk due to systemic disease affecting the pulmonary, renal and cardiovascular system, and represent an important population to consider regarding risk of heat related illness [6,7]. It is especially important that messaging and support be offered to patients facing the highest risk of heat-related health impacts. In the future, use of medical records data, demographic information, geocoding, and other risk stratification tools could be considered to focus efforts on patients most likely to benefit from heat health assessments and counseling and thus guide the judicious use of heat advice in time constrained ambulatory clinic settings.

4.2. Limitations

This pilot project describes a single season implementation in a single institutional setting. The sample size was limited to 12 staff members and a total of 4 days meeting criteria for project activities. Staff engagement levels were assessed via self-estimated recall, rather than in real time, and no health or behavior change outcomes were assessed amongst patients in this pilot study.

5. Conclusion

This pilot study demonstrates that an external heat alert system can support a heat health engagement and education program in an ambulatory clinic setting. Replication of this project in other settings and assessment of patient perspectives and outcomes related to clinic-based heat health interventions should be pursued in future studies. Refining and targeting this approach toward vulnerable patient populations may provide a practical avenue for action to help meet the needs of our patients as they face increasingly dangerous environmental exposures related to climate change.

Funding statement

There was no specific grant funding for this study.

Disclosures: FDA Advisory Committee Up to date

[b]Disclosure: research support from the Arthritis Foundation, BMS Foundation, the NIH and the BWH Department of Medicine. I serve on the ACR Climate Change Task Force and the DEI Committee. Have consulted for Bain Capital, LP, Havard Pilgrim and OM1, Inc. unrelated to this work.

[c]Disclosure: none

[d]Disclosure: none

[e]Disclosures: Grant or gift funding from the NIH Climate & Health Program, the Climate and Health Foundation, Climate Central, the Harvard Mittal South Asian Institute, Johnson & Johnson, and Biogen. He has performed consulting for Columbia University, Direct Relief, and the Ministry of Health and Wellness of the Bahamas. Serve on the External Advisory Board for the UMass Boston Sustainable Solutions Lab and the Technical Expertise Panel for the NIEHS Climate and Health Outcomes Research Data Systems (CHORDS) initiative

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT authorship contribution statement

Paul F Dellaripa: Project administration, Data curation, Supervision, Conceptualization, Writing – review & editing, Methodology, Writing – original draft, Formal analysis. **Candace Feldman:** Writing – original draft, Methodology, Project administration, Writing – review & editing, Funding acquisition, Investigation, Conceptualization. **Lydia Gedmintas:** Writing – review & editing, Data curation, Resources, Investigation. **Susan Ritter:** Writing – review & editing, Project administration, Investigation. **Caleb Dresser:** Writing – original draft, Formal analysis, Writing – review & editing, Data curation.

Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.joclim.2025.100478.

References

[1] Ebi KL, Capon A, Berry P, Broderick C, de Dear R, Havenith G, et al. Hot weather and heat extremes: health risks. Lancet 2021;398(10301):698–708 Aug 21PMID: 34419205. doi: 10.1016/S0140-6736(21)01208-3.

[2] Calvin K, Dipak D, Krinner G, Mukherji A, Thorne P, Lee H, et al. Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. In: Lee H, Romero J, editors. Climate change 2023. ipcc. Geneva, Switzerland: IPCC; 2023. p. 35–115. doi: 10.59327/IPCC/AR6-9789291691647.

[3] Habeeb D, Vargo J, Stone B. Rising heat wave trends in large US cities. Nat Hazards 2022;76:1651–65. doi: 10.1007/s11069-014-1563-z.

[4] Bell ML, Gasparrini A, Benjamin GC. Climate change, extreme heat, and health. N Engl J Med 2024;390(19):1793–801 May 16PMID: 38749034. doi: 10.1056/NEJMra2210769.

[5] National Integrated Heat Health Information System (NIHHIS). Who is most at risk to extreme heat? https://www.heat.gov/pages/who-is-at-risk-to-extreme-heat/; 2024 accessed October 18, 2024.

[6] Santacroce L, Dellaripa PF, Costenbader KH, Collins J, Feldman CH. Association of area-level heat and social vulnerability with recurrent hospitalizations among individuals with rheumatic conditions. Arthritis Care Res (Hoboken) 2023;75(1):22–33 JanEpub 2022 Oct 12PMID: 36071609PMCID: PMC9947700. doi: 10.1002/acr.25015.

[7] Katsumoto T, Stolyar L, Dandeniya C, Wong H, Lanata C, Falasinnu T, et al. Impact of climate change on rheumatic diseases: a scoping review. J Climate Change Health 2024;19. doi: 10.1016/j.joclim.2024.100338.

[8] Toloo G, FitzGerald G, Aitken P, Verrall K, Tong S. Evaluating the effectiveness of heat warning systems: systematic review of epidemiological evidence. Int J Public Health 2013;58(5):667–81 OctEpub 2013 Apr 7PMID: 23564031. doi: 10.1007/s00038-013-0465-2.

[9] Weinberger KR, Wu X, Sun S, Spangler KR, Nori-Sarma A, Schwartz J, et al. Heat warnings, mortality, and hospital admissions among older adults in the United States. Environ Int 2021;157:106834 DecEpub 2021 Aug 27PMID: 34461376PMCID: PMC11549953. doi: 10.1016/j.envint.2021.106834.

[10] Climate Central. Real Time Climate Heat Risk. https://www.climatecentral.org/realtime-climate-heat-risk; 2024 accessed October 18, 2024.

[11] National Weather Service. NWS HeatRisk: identifying potential heat risks in the seven day forecast accessed October 18 https://www.wpc.ncep.noaa.gov/heatrisk/2024; 2024 accessed October 18.

[12] United States Centers for Disease Control and Prevention. Heat risk accessed October 18 https://ephtracking.cdc.gov/Applications/HeatRisk/2024; 2024 accessed October 18.

[13] Vaidyanathan A, Saha S, Vicedo-Cabrera AM, Gasparrini A, Abdurehman N, Jordan R, et al. Assessment of extreme heat and hospitalizations to inform early warning systems. Proc Natl Acad Sci U S A 2019;116(12):5420–7 Mar 19Epub 2019 Mar 4PMID: 30833395PMCID: PMC6431221. doi: 10.1073/pnas.1806393116.

[14] Americares. The climate resilience for Frontline clinics toolkit accessed October 18 https://www.americares.org/what-we-do/community-health/climate-resilient-health-clinics/2024; 2024 accessed October 18.

[15] United States Centers for Disease Control and Prevention. Heat health: resources for everyone and resources for health care providers. https://www.cdc.gov/heat-health/about/index.html; 2024 accessed October 18, 2024.