Planning to Reduce the Health Impacts of Extreme Heat: A Content Analysis of Heat Action Plans in Local United States Jurisdictions

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See also Guardaro, p. 465.

Objectives. To examine commonalities and gaps in the content of local US heat action plans (HAPs) designed to decrease the adverse health effects of extreme heat.

Methods. We used content analysis to identify common strategies and gaps in extreme heat preparedness among written HAPs in the United States from jurisdictions that serve municipalities with more than 200 000 residents. We reviewed, coded, and analyzed plans to assess the prevalence of key components and strategies.

Results. All 21 plans evaluated incorporated data on activation triggers, heat health messaging and risk communication, cooling centers, surveillance activities, and agency coordination, and 95% incorporated information on outreach to at-risk populations. Gaps existed in the specific applications of these broad strategies.

Conclusions. Practice-based recommendations as well as future areas of research should focus on increasing targeted strategies for at-risk individuals and expanding the use of surveillance data outside of situational awareness. (*Am J Public Health*. 2023;113(5):559–567. https://doi.org/10.2105/AJPH.2022.307217)

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As many regions in the United States experience increases in average temperatures attributable to climate change, extreme heat events have increased in frequency and duration.[1,2] Heat is a hazard that can combine with other environmental factors such as ozone and humidity to have catastrophic public health consequences.[3,4] Exposure to high heat is associated with increased emergency department visits, hospital admissions, and mortality rates and is tied to exacerbations of chronic conditions such as heart disease, stroke, diabetes, and acute renal failure.[5–7]

From May to September each year, an average of 65 000 US residents visit emergency departments for heat exhaustion and heat stroke.[8] The Centers for Disease Control and Prevention (CDC) estimates that from 2004 to 2018 there were 10 527 deaths attributable to heat, approximately 702 deaths annually.[9] Heat-related illness, emergency department visits, and deaths are likely underestimated, with data missing on cases in which health conditions exacerbated by heat are attributed to another cause (e.g., cardiovascular disease).[8,10–12]

Studies involving other methods of estimation have produced mortality results much higher than CDC estimates.[11,12] For example, Shindell et al. estimated 12 000 heat-related deaths annually (95% confidence interval [CI] = 7400, 16 500), and Weinberger et al. estimated 5608 deaths annually (95% CI = 4748, 6291) in the contiguous United States.[11,12]

High heat has differing population and location effects. For example, 1 US study showed that heat-related deaths were highest among males, older adults, non-Hispanic Blacks, American

Indians/Alaska Natives, and those living in large metropolitan counties where the urban heat island effect (in which cities experience higher temperatures than surrounding rural areas as a result of building materials, air pollution, traffic, and decreased vegetation) is strongest.[9,13] Others most at risk include young children and people who are socially isolated, unhoused, working outdoors, or experiencing mental, cognitive, or other chronic illnesses.[8]

Heat action plans (HAPs) are written documents that help manage actions across multiple organizations to reduce adverse health effects from extreme heat. HAPs broadly contain strategies such as performing surveillance, providing risk communication, supporting social and health care, establishing cooling centers, distributing water bottles and fans, and creating energy assistance programs.[10,14] The geographic scope, timing, content, and participating organizations vary and depend on factors such as the partners involved in creation and implementation, capacity and resources available to lead agencies, and the populations within service areas. HAPs may decrease heat-related mortality to varying extents, although further research on evaluation and implementation is needed.[15–17] Often a component of HAPs, heatwave early warning systems provide alerts on heat risk and preventive actions and are activated by forecasted temperatures or other weather conditions.[14,18,19]

To our knowledge, there has not been a systematic assessment of the content of local US HAPs since 2004, including response strategies and their alignment with evidence-informed practice.[20] In response, we assessed the content of HAPs in large US cities and counties.

METHODS

Leveraging previous extreme heat response research and CDC-released guidance on core components of HAPs (specifically a report that combined findings from the literature and case studies on extreme heat response), we adapted legal assessment techniques to explore the content of US local HAPs.[10] Specific components recommended by the CDC include activation threshold, health data use, identification of vulnerable populations, monitoring and evaluation, and plan updates.[10] Potential interventions include surveillance, messaging and communications, social care and front-line health, cooling centers, water bottle distribution, fan distribution, energy assistance, changes to the built environment, and workplace heat alert programs.[10]

Study Population

We included municipalities with more than 200 000 residents according to the US Census Bureau's 2019 Annual Estimates of the Resident Population for Incorporated Places.[21] To obtain HAPs, we conducted a Web search, targeted outreach to local health departments and offices of emergency management (OEMs), and used plans previously obtained by journalists for their own research.[22] In total, 117 municipalities with an estimated population of 68 million people (20% of the US population) were included.[21] We identified 99 unique jurisdictions for inclusion as a result of instances in which county-level OEMs and public health agencies serve multiple jurisdictions. Our focus was informed by previous research identifying larger municipalities as more likely to have developed HAPs as a result of their size and available resources.[23]

Heat Action Plan Collection

An initial sample of HAPs from a journalistic source was supplemented with plans obtained directly from agencies.[22] We conducted Web searches for HAPs in jurisdictions with more than 200 000 residents using keywords such as "extreme heat," "heatwave," "heat action plan," "heat early warning system," "heat adaptation," and "public health heatwave management" in addition to local health department, OEM, jurisdiction, county, or city name. Also, we conducted searches for documents posted on agency Web sites by using the sites' search functions and the keywords just described. We then searched linked Web pages for downloadable plans. This strategy did not produce any downloadable plans but did inform the initial sampling frame for surveying agencies about their HAPs.

We conducted outreach as part of a national electronic survey that was active from September 2021 to January 2022. Surveys were sent to e-mail addresses of representatives (including emergency management directors, health directors or officers, and environmental health or public health preparedness coordinators) at local health departments and OEMs obtained from agency Web sites or from follow-up telephone calls to agencies. Although multiple representatives for each jurisdiction were contacted, they were asked to coordinate responses. In total, we sent 4 reminder e-mails beyond the initial contact e-mail and extended the active survey window to incorporate further responses.

We collected survey data using the online electronic data collection software

REDCap (Research Electronic Data Capture). As part of the survey, jurisdictions were asked whether they had a written HAP, policy, or procedure and were asked to upload their most recently updated document (or documents).

Inclusion and Exclusion

Inclusion criteria for documents were as follows: standalone HAPs, standard operating procedures, checklists, protocols, or annexes to emergency or hazard mitigation plans used for extreme heat emergencies. Also, HAPs had to have been created or updated since 2016. HAPs were excluded if they were (1) emergency or hazard mitigation plans that did not include specific actions to address extreme heat preparedness and response during heat emergencies or (2) plans that did not address response to acute heat emergencies but instead focused on long-term planning.

Analysis

We adapted legal assessment and qualitative content analysis techniques and systematically applied categorical classification by coding the plan text and using the coded text to answer specific questions.[24] Codebook development proceeded through a combination of methods. Components of HAPs identified by the CDC and previous research on county-level heat preparedness and response were used to develop the analytical framework and preliminary set of codes through deductive methods.[10,23] After review of a sample of plans, we inductively developed additional codes to identify parts of plans that deductive codes were not able to capture (e.g., whether cooling center locations are predetermined or established ad hoc during emergencies), as well as corresponding coding questions.[25,26]

Codes included definitions and directions for use (Appendix A, available as a supplement to the online version of this article at http://www.ajph.org). We developed coding questions in binary or categorical formats and linked them to specific codes (Figure 1 and Appendix B, available as a supplement to the online version of this article at http://www.ajph.org). We documented revisions to codes and used NVivo for PC software (QSR International, Burlington, MA) to code HAPs. When there was ambiguity or nuance, records of the coder's decisions were logged. Ten percent of HAPs were co-coded by 2 investigators (J. M. R. and a non-author collaborator) independently, and results were compared and evaluated for discrepancies to refine code definitions and provide examples of application.[25] J. M. R. coded the remainder of plans. We recorded answers to coding questions in a Microsoft Excel database and synthesized code content to illustrate common strategies and gaps in plans.[27]

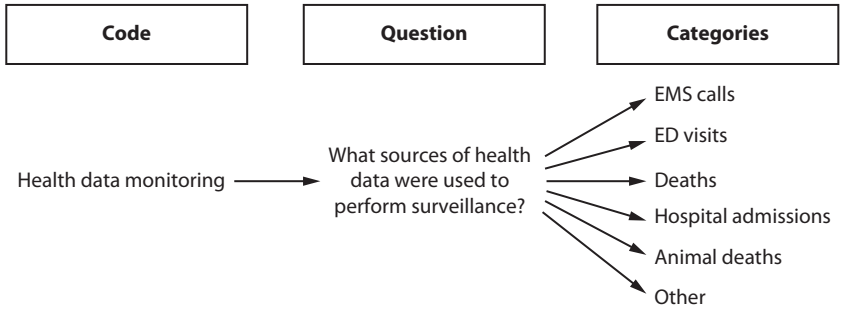

FIGURE 1— Codes, Corresponding Coding Questions, and Categories of Data Obtained From Coding Questions for Analysis of US Heat Action Plans

Note. ED = emergency department; EMS = emergency medical service.

RESULTS

We obtained and analyzed 21 plans, 9 (42.9%) from previous journalistic research and 12 (57.1%) from our survey responses. The jurisdictional populations covered by these plans ranged from 321 793 to 8 467 000, with a median of 967 640 people. We did not identify additional plans after conducting Web searches. Of the analyzed plans, 14 (66.7%) were standalone or separate from larger all-hazards plans, and 17 (81.0%) listed an OEM as lead or co-lead of plan administration. Although public health agencies had a role in the implementation of all plans, only 6 (28.6%) plans listed them as the lead or co-lead.

Seven of the 10 US Department of Health and Human Services administrative regions were represented in our analysis (Figure 2). Table 1 displays an overview of the different types of strategies and the numbers and percentages of plans that addressed the strategies.

Plan Activation, Scaling, and Termination

Twenty plans (95.2%) used National Weather Service (NWS) advisories as triggers for plan activation, with 7 of these plans (35.0%) using NWS alerts as the sole trigger. Other plans combined alerts with triggers such as epidemiological surveillance thresholds

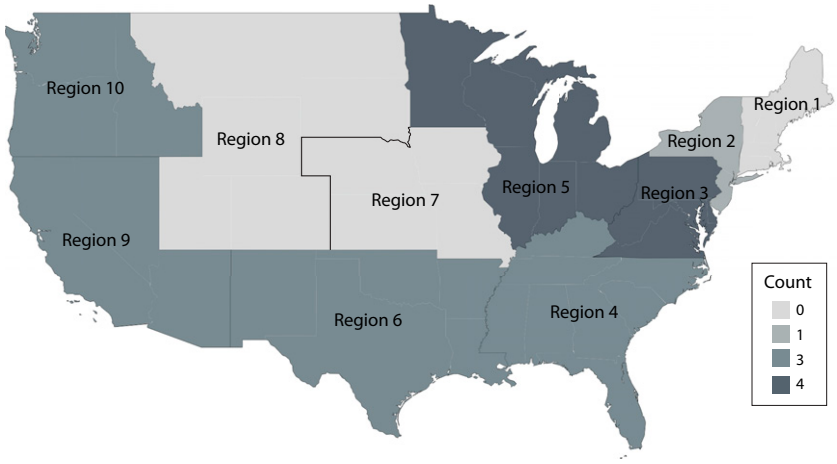

FIGURE 2— Geographical Distribution of Analyzed Heat Action Plans by US Department of Health and Human Services Region: United States, 2016–2021

linked to deaths or heat illness, the heat index independent of NWS alerts, ongoing infrastructure effects such as rolling blackouts, stakeholder requests, and abnormal livestock mortality rates. Seventeen plans (81.0%) also included definitions relevant to heat waves such as heat index, extreme heat, heat advisory, excessive heat warning or watch, excessive heat outlook, and heat-related mortality. The NWS was the source of most definitions (71.4%).

Seventeen plans (81.0%) incorporated scaled responses in which different levels of agency response were triggered seasonally or according to heat event severity. For example, date-based triggers were used to commence early season risk communication strategies and epidemiological surveillance. Extreme high heat indexes were used in triggering activation of emergency operations centers to coordinate interagency responses, whereas lower heat indexes were in some instances used in triggering smaller-scale situational awareness activities between agencies.

Eight plans (38.1%) described response deescalation through either specific thresholds (e.g., expiration or cancellation of heat advisories or warnings from the NWS) or deactivation activities such as termination alerts to participating organizations and agencies.

Risk Communication

All plans included strategies for communicating risks associated with extreme heat to the public. Recipients of information on specific communication strategies included at-risk populations (71.4%), community-based organizations (33.3%), government agency staff members (33.3%), social and case workers (14.3%), schools and day-care centers (14.3%), health care providers (14.3%), and first responders (9.5%). Message content included alerts and warnings, heat safety tips, encouragement to "check in with your neighbor," reminders to conserve power, and

TABLE 1— Heat Action Plans That Included Heat Action Strategies: United States, 2016–2021

Strategy	% (No.)	DHHS Regions With Strategy Performed
Risk communication	100.0 (21)	All regions represented in study
Surveillance and monitoring	100.0 (21)	All regions represented in study
Interagency and interorganizational coordination	100.0 (21)	All regions represented in study
Cooling centers	100.0 (21)	All regions represented in study
Targeted outreach to at-risk populations	95.2 (20)	All regions represented in study
Scaled response	81.0 (17)	All regions represented in study
Social care interventions	66.7 (14)	All regions represented in study
Update and review	66.7 (14)	3, 4, 5, 6, 9, 10
Cooling shelters	48.0 (10)	3, 4, 5, 6, 9
Health interventions	43.0 (9)	3, 4, 5, 6, 10
Plan termination	38.1 (8)	3, 4, 6, 9, 10

Note. DHHS = Department of Health and Human Services. See Figure 2 for region numbers.

information on service provisions such as the locations of cooling centers.

Eighteen plans (85.7%) listed the intended communication platforms for message dissemination. The most common forms of communication were traditional media sources such as radio and television, call centers, government agency Web sites, emergency alert systems, and social media.

Seven plans (33.3%) included strategies promoting language accessibility in communication materials. Common strategies included creating outreach materials in Spanish or multiple languages, providing closed captioning or sign language for press releases, and releasing alerts in plain language or accessible formats according to agency guidelines.

Surveillance and Monitoring

All plans detailed surveillance or monitoring. In the case of 2 plans, however, this was restricted to monitoring weather forecasts and NWS notifications rather than collecting in-house data. Eighteen plans (85.7%) detailed health data collection, the most common forms of which were emergency department visits, deaths, hospital admissions, and emergency medical service calls. Sixteen plans (76.2%) explicitly described monitoring weather and other environmental data such as air quality and humidity through NWS or other forecasts. Ten plans (47.6%) included monitoring at-risk populations such as people using shelters or those experiencing houselessness, residents of skilled nursing and assisted living facilities, and people reliant on medical equipment. Plans also described collecting information on cooling center use, fire and police call volumes, and utility infrastructure conditions.

Surveillance and monitoring data were most often used for situational awareness (e.g., resource needs, event cancellations and modifications, energy infrastructure status, and demand on the health care system) during heat events. Data were used less frequently after heat events (e.g., in end-of-summer reporting, heat response reviews, and damage assessments) or to track health trends over time.

Agency Coordination

All plans described coordination between lead agencies and supporting government agencies (at the city, county, state, and federal levels) and between lead agencies and nongovernmental and private organizations. To manage coordination between agencies and jurisdictions, 16 plans (76.2%) incorporated incident response structures (e.g., the National Incident Management System) or activation of an emergency operations center. Coordination strategies included developing situation reports and hosting briefings, organizing task forces, preestablishing points of contact, holding annual preseason stakeholder meetings, and using WebEOC or other emergency management software to share information. Coordination strategies created opportunities for situational awareness, provision of agency-specific data and identification of concerns, organization of planning efforts for response and recovery, and management of resource and mutual aid requests between different organizations, agencies, and levels of government.

Descriptions of coordination between agencies and nongovernmental, private, and faith-based organizations involved multidirectional information exchange. Plans indicated that agencies would provide alerts and updates at the beginning of and during heat emergencies, whereas nongovernmental organizations were often described as sources of information for monitoring at-risk populations. Nongovernmental organizations were also described as providing services such as staffing cooling centers and conducting well-being checks. These activities required communicating resource needs and updates to emergency and public health agencies. Plans described other opportunities for coordination as well, such as development of organizational response plans, inclusion of organizational representatives in task forces and planning activities, and amplification of communication efforts.

Cooling Centers and Shelters

All plans included descriptions of cooling center or shelter implementation. Cooling shelters, meant for overnight stays and most often intended for people experiencing houselessness, were described separately from cooling centers, with some plans providing specific definitions for each. Ten (47.6%) plans referenced cooling shelter strategies such as predetermined locations and transportation to sites.

Implementation considerations for cooling centers included resources such as water, seating, and first aid as well as operational considerations such as staffing and finding locations accessible for people with access or functional needs. Two thirds (66.7%) of plans incorporated strategies to provide access to transportation to cooling centers or shelters. These strategies included waiving transit fees to cooling centers and providing transportation to specific populations such as those experiencing houselessness, older adults, and people with access or functional needs.

Plans described predetermined locations (42.9%), ad hoc locations (42.9%), or a combination of both (9.5%) or did not specify locations (4.7%) for cooling centers or shelters. Common locations included senior centers, recreation and community centers, buses, libraries, jurisdictional facilities, faith-based or nonprofit-operated facilities, shopping malls, movie theaters, restaurants, and park facilities such as pools and spray parks.

Health and Social Care

Ten plans (47.6%) described health system–related interventions such as creating mobile hospitals and clinics, providing first aid and triage at cooling centers and cooling buses, stocking appropriate medical supplies for field personnel, providing spiritual and emotional care, requesting additional emergency medical service system capacity, and communicating risks to health care personnel and first responders. Fourteen plans (66.7%) included strategies for well-being and in-home checks from community-based organizations, social workers, and other providers.

Targeted Outreach

All plans identified specific populations most at risk for effects of extreme heat. Twenty plans (95.2%) detailed specific outreach and communication strategies for people at risk, with 16 (76.2%) including 1 or more general outreach strategies to "at-risk populations" without specifying populations or individuals and 15 (71.4%) including 1 or more outreach strategies to specific populations or individuals (Figure 3).

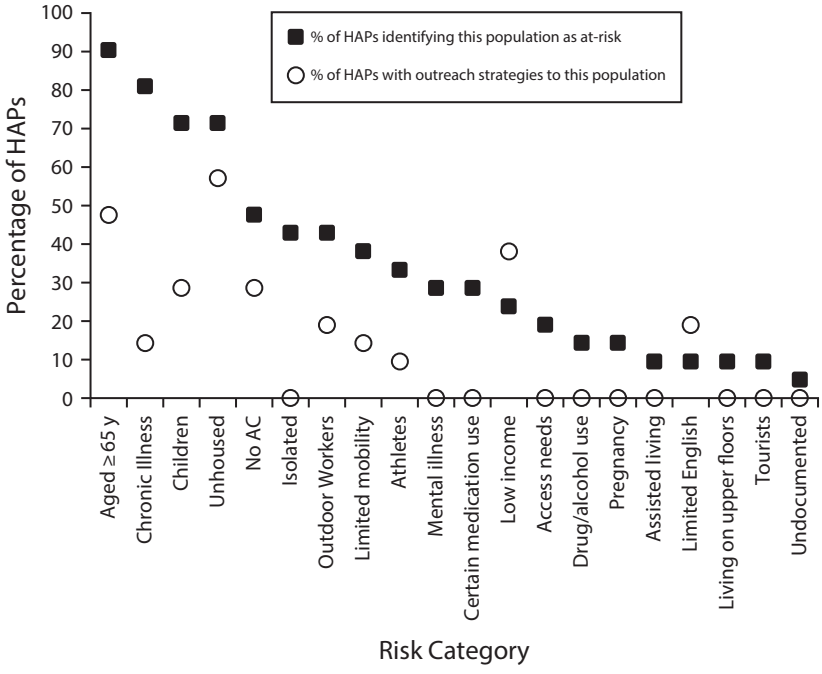

FIGURE 3— Percentage of Populations Identified as At-Risk in Heat Action Plans (HAPs) Compared With Percentage of Populations Targeted Through Specific HAP Outreach Strategies: United States, 2016–2021

Note. AC = air conditioning.

General strategies included partnerships with organizations for communicating risks, identifying at-risk populations, conducting well-being checks, and providing transportation or evacuation to cooling centers and shelters. Specific strategies included water distribution, financial assistance, building inspections, modification of athletic events, and coordination with school districts.

Although 5 plans (23.8%) explicitly identified low-income residents as at risk for heat effects, only 1 incorporated financial assistance programs. Seven plans did not identify low-income residents as at risk but included financial assistance programs such as utility moratoriums, utility assistance, and fan or air conditioner distribution.

Update and Review

Fourteen plans (66.7%) described processes for update and review such as conducting updates (61.9%), providing staff or responder training (28.6%), and conducting postevent reviews (28.6%). One plan incorporated all these processes and 9 incorporated 2 of the processes. Timing varied among the plans that included update procedures, with about half occurring annually (53.8%) and others occurring every 2 years (7.7%), every 3 years (7.7%), after an event (23.0%), or at an unspecified point (30.8%). In 3 plans (23.0%), updates were performed after both a specific number of years and an event. Postevent reviews occurred as after-action discussions (e.g., hot washes), reports, and improvement plans. Four of the plans (66.7%) that did include postevent reviews specified incorporation of surveillance data into review processes.

DISCUSSION

As heat waves threaten the health and well-being of residents in many regions of the United States, HAPs at the local level can bridge gaps between research and practice by incorporating evidence-informed strategies and play a key role in guiding multiorganizational responses during extreme heat emergencies. The HAPs reviewed in this study included many recommendations from previous research on heat response as well as CDC guidance.

Most, if not all, plans identified a lead agency, provided activation triggers, and described strategies for heat health messaging and risk communication, cooling centers, surveillance activities, at-risk population outreach, and agency coordination. Although plans incorporated most major categories of strategies, applications and inclusion of implementation and evaluation components varied. All plans identified specific at-risk populations, the most common of whom were older adults, people living with acute or chronic illness, infants and children, and people experiencing houselessness. Strategies that included specific at-risk populations were most often aimed at older adults or those experiencing houselessness.

As demonstrated in Figure 3, gaps exist between populations considered at risk by the plans and specific outreach to these populations. In addition, given that other populations are also at risk for extreme heat, opportunities exist for increased outreach and dissemination of communications to these populations. For example, only 2 plans described communication to health care providers, who can act as trusted sources of information for patients and may provide targeted outreach to otherwise historically underserved people who have certain illnesses or use certain medications.[28] Although many plans incorporated varied platforms for risk communication, only 33% included language accessibility in their communication strategies and only 9.5% identified people with limited English proficiency as at risk for extreme heat, despite previous research indicating limited English proficiency as a risk factor for poor outcomes during disasters.[29]

Although all plans included strategies for surveillance and monitoring, few described use of the information derived from these activities to inform implementation or evaluation activities. The CDC recommends that epidemiological surveillance be used to determine people, places, and times of greatest risk.[10] Epidemiological data have also been used by academic institutions and jurisdictions in collaboration with the NWS to revise heat advisory levels.[30–32] These uses of surveillance data occur outside active emergency situations, yet current applications focus on immediate use for situational awareness. Use of surveillance data in planning and recovery efforts presents an opportunity to increase and bolster plan monitoring and evaluation, a neglected component of HAPs.

Notably absent in the analyzed HAPs were long-term planning strategies such as green roofs, parks, and green space and vegetation, which are recommended by the CDC and are linked to cooler city microclimates.[10] This may be a result of the emergency response focus of the analyzed plans and the exclusion of plans focused on longer-term mitigation.[33] Partnerships at the local level between OEMs and city planning and sustainability divisions, however, are an important component of long-term heat planning and should be prioritized. Additional research is necessary to explore integration of such longer-term strategies in hazard mitigation and climate adaptation plans.

Limitations

Our study included only plans available online or shared by jurisdictions. The COVID-19 pandemic likely limited the capacity of local health departments to respond to our survey and provide their HAPs. This convenience sampling approach limits the generalizability of our results in addition to precluding assessment of geographic differences in heat preparedness and response, which is an important area for future research. Notably, key strategies and gaps identified in our analysis were from plans of large, well-resourced jurisdictions expected to be furthest in plan development. Furthermore, cities that provided plans may have been more advanced in their planning than those that did not.

Also, the plans included in our study may not be the most recent or inclusive of all heat adaptation activities within a given jurisdiction. In addition, we were unable to determine the extent to which plans were implemented. Plan implementation and population health effects are areas for future research. Finally, plans that were not specific to heat, such as comprehensive emergency management plans, were excluded. Strategies outlined in comprehensive emergency management plans, such as mass care, may have application in heat emergencies but were excluded because the conditions and extent to which these strategies would be employed during a heat emergency were not apparent.

Public Health Implications

HAPs are policy tools that engage multiple stakeholders in extreme heat planning and can help guide responses

during heat emergencies, potentially reducing the morbidity and mortality associated with these events. This study provides insight into current strategies and gaps in jurisdictional extreme heat planning in the United States. Although many plans incorporate components identified by research and government guidance, opportunities exist to increase language accessibility, implement strategies targeted to specific at-risk groups, and incorporate surveillance into planning. Responsive plan updates can be supported through agency and organizational partnerships, development of new guidance and templates, and technical assistance. AJPH

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CONTRIBUTORS

J. M. Randazza, J. J. Hess, A. Bostrom, A. Nori Sarma, K. R. Weinberger, G. A. Wellenius, and N. A. Errett designed the research, with input from C. Hartwell, Q. H. Adams, K. R. Spangler, and Y. Sun. J. M. Randazza, C. Hartwell, and N. A. Errett contributed to the implementation of the research. J. M. Randazza, J. J. Hess, A. Bostrom, C. Hartwell, K. R. Spangler, K. R. Weinberger, G. A. Wellenius, and N. A. Errett contributed to the analysis of the results. All authors contributed to the interpretation of results and writing of the article.

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CONFLICTS OF INTEREST

G. A. Wellenius receives consulting income from the Health Effects Institute (Boston, MA) and Google LLC (Mountain View, CA). All other authors declare no competing interests.

HUMAN PARTICIPANT PROTECTION

No human participant data were gathered or reviewed. This study was determined not to be human participant research by the University of Washington's Human Subjects Division.

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