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The Montreal heat response plan: evaluation of its implementation towards healthcare professionals and vulnerable populations

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Abstract

Objectives Since 2004, the Montreal heat response plan (MHRP) has been developed and implemented on the Island of Montreal to reduce heat-related health effects in the general population. In this paper, we aimed to assess the barriers and facilitators to implementation of the MHRP and evaluate the awareness of key elements of the plan by healthcare professionals and individuals from vulnerable populations.

Methods Data were gathered from monitoring reports and a questionnaire administered to managers of healthcare institutions and healthcare workers in Montreal-area health and social services institutions. Individual interviews and focus groups with healthcare workers and with individuals with schizophrenia or suffering from drug or alcohol dependencies were performed. Data were categorized according to predefined subthemes. Coding matrices were then used to determine the most frequently occurring elements in the subthemes.

Results Our results indicate that actions are progressively implemented each year in the healthcare network. Intensification of surveillance for signs of heat-related illness is the most frequently reported measure. Identification and prioritization of clientele and homecare patients are identified as a challenge, as is ensuring the availability of sufficient personnel during a heat wave. Analysis of practice and awareness in healthcare professionals reveals that preventive measures are known and applied by the personnel. Individuals from vulnerable population groups were not uniformly aware of preventive measures, and consequently, variability was observed in their application.

Conclusion The framework proposed in this study revealed valuable information that can be useful to improve plans aimed at reducing heat-related health effects in the population.

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Résumé

Objectifs Le Plan chaleur accablante ou extrême a été développé et mis en œuvre sur l'Île de Montréal depuis 2004 dans le but d'atténuer les effets sur la santé en lien avec la chaleur chez la population générale. Cet article dresse un portrait des éléments facilitateurs et des défis rencontrés lors de la mise en œuvre du plan chaleur. L'article présente également une évaluation de la connaissance des professionnels de la santé et de la population vulnérable quant à certains éléments-clés du plan chaleur.

Méthodes L'information a été recueillie à l'aide de rapports de suivi et à l'aide d'un questionnaire administré aux gestionnaires et aux professionnels de la santé œuvrant dans les institutions de santé et de services sociaux sur l'Île de Montréal. De plus, des entrevues individuelles et des groupes de discussion ont été réalisés auprès de travailleurs de la santé et auprès d'individus vivant avec la schizophrénie ou ayant

des dépendances aux drogues ou à l'alcool. L'information recueillie a été catégorisée selon des thèmes prédéfinis et les éléments les plus fréquents ont été identifiés à l'aide de matrices.

Résultats L'analyse des résultats permet de constater la mise en œuvre graduelle des mesures de prévention lors d'épisodes de chaleur. La surveillance accrue des signes et symptômes des effets de la chaleur est la mesure la plus souvent mentionnée dans l'information recueillie. Les principaux défis soulignés sont l'identification et la priorisation de la clientèle et des patients à domicile ainsi que s'assurer d'un personnel suffisant lors d'un épisode de chaleur extrême. Les résultats indiquent que les travailleurs de la santé connaissent et appliquent les mesures de prévention. Quant aux résultats ayant trait aux populations plus vulnérables, l'information sur les mesures de prévention n'était pas connue de tous et conséquemment, l'application efficace de ces mesures n'était pas observée dans tous les groupes.

Conclusion Cet article propose une méthodologie pouvant être applicable à l'amélioration des plans de réponse pour la chaleur extrême, visant ainsi la réduction des effets de la chaleur chez la population.

Keywords Extreme heat · Environment · Public health

Mots-clés Chaleur extrême · Environnement · Santé publique

Introduction

Extreme heat events in cities are a common cause of weather-related mortality (Price et al. 2013; Gasparrini and Armstrong 2011). Climate change is expected to result in an increase in weather-related health outcomes in Canadian cities like Montreal (Benmarhnia et al. 2014). In order to mitigate the health impact of extreme heat events, public health authorities have developed and implemented policies, including heat prevention and response plans.

A regional heat prevention and response plan has been in place on the Island of Montreal since 2004. According to the Montreal heat response plan (MHRP), a baseline set of preventive measures is recommended for the duration of the summer months. In addition, specific measures are deployed during days designated as “heat waves” on the basis of local meteorological and health-related indicators, which are monitored on a daily basis by the Montreal Public Health Department,¹ (Agence de la santé et des services sociaux de Montréal (ASSSM) 2014).

During the summer of 2010, there was a severe heat wave for five consecutive days (Price et al. 2013). A total of 106 heat-related deaths were recorded during the 5-day period, with 32 of these deaths observed in people with mental illness. In 2011, the Montreal Public Health director issued a series of recommendations aimed at improving the implementation of the plan for future events (Roy et al. 2011). These recommendations were integrated into a revised version of the heat response plan in 2012 (Agence de la santé et des services sociaux de Montréal (ASSSM) 2012). The revised plan includes people with

mental illness and others as vulnerable subgroups to target.

The current MHRP comprises five levels of intervention (normal, seasonal watch, active watch, alert, and intervention) during which specific actions are undertaken by the health network. The “intervention” level of the MHRP was reached in 2010 and 2011, and the “alert” level was reached in 2012 and 2013. Figure 1 illustrates the general logic model for the MHRP and describes resources involved and goals for the short, medium, and long term.

Preventive measures deployed as part of the heat plan apply to the entire population, although some actions are focused towards individuals that may be more vulnerable to heat. In the MHRP, vulnerable individuals include the elderly and those with certain chronic physical or mental illness, in particular when there is no access to air conditioning in the home or when individuals are living alone or are socially isolated.

Assessments of the perceptions of public health campaigns about heat have been reported (Abrahamson et al. 2009; Black et al. 2013). However, evaluations of heat warning systems, as reported in the current article, are scarce in the published literature (Bassil and Cole 2013; Toloo et al. 2013), and data concerning implementation of heat plans is rare, in particular when looking at interventions targeted towards vulnerable populations or individuals.

In this paper, we present a qualitative evaluation of the implementation of the MHRP, focusing on two components: (i) the implementation of the heat plan (component A), including a description of the actions undertaken, of obstacles and facilitating factors, and of the acceptability of the measures proposed in the MHRP, and (ii) awareness and application of actions contained in the MHRP by healthcare professionals and individuals from vulnerable populations (component B) (Fig. 2). These major themes follow the framework proposed by Damschroder et al. (2009).

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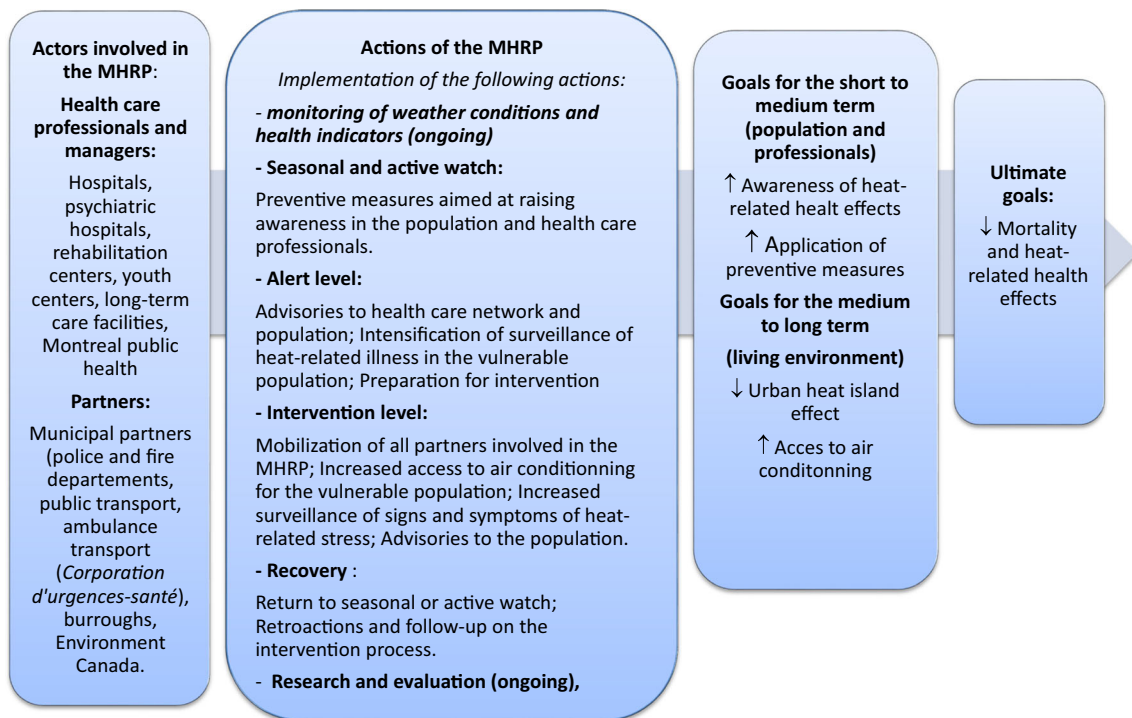


Fig. 1 Logic model for the Montreal heat response plan (MHRP)

Methods

Data sources

Data for the current study were gathered from five sources: (1) 21 seasonal reports (for the years 2010–2013) from Montreal-area health and social services institutions, including local health administrative units, hospitals, psychiatric hospitals, public and private rehabilitation centres, youth centres, and public long-term care facilities; (2) a questionnaire sent out to all local health administrative units ($n = 13$) in the spring of

2014; (3) individual interviews with two healthcare workers (one home care service manager and one home care assistant) from one local health administrative unit in autumn of 2013; (4) two guided and semi-structured focus groups with two healthcare workers from community organizations and five healthcare workers from psychiatric hospitals undertaken in autumn of 2013; and (5) two focus groups with individuals from population groups labeled as vulnerable in the plan (nine with schizophrenia and ten suffering from drug or alcohol dependencies), also in autumn of 2013.

Healthcare workers for individual interviews were recruited based on targeted territories according to socio-demographic characteristics of the population. Three territories were initially identified, but only participants from the Cœur-de-l'Île local health unit were mobilized because of difficulty in recruitment. This territory, however, covers a number of centrally located neighbourhoods with a diversity of vulnerable populations. Healthcare workers for guided and semi-structured focus groups were recruited from a psychiatric hospital and community organizations that offered services to people with mental health problems and with drug or alcohol dependencies throughout the Island of Montreal. The selection of participants with schizophrenia and those suffering from alcohol or drug abuse was established with the help of key community partners of the Montreal Public Health Department, who have been involved in the development of the heat action plan for many years. Informed, written consent was received from participants prior to the commencement of

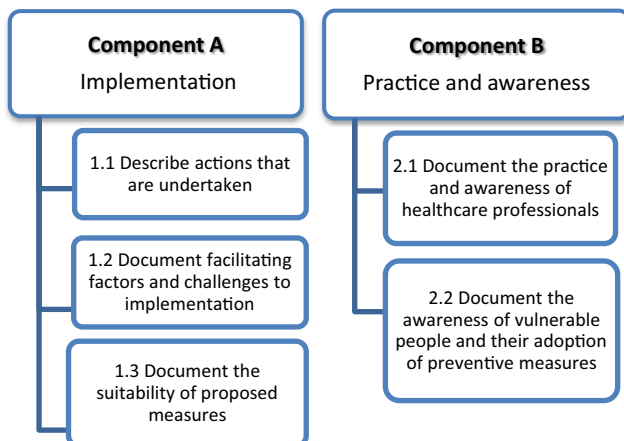


Fig. 2 Description of the study objectives

the focus groups, and assurances of anonymity and confidentiality were provided.

The seasonal reports and the questionnaires were mainly answered by managers of healthcare institutions or healthcare worker managing teams responsible for the implementation of the MHRP in their institution. The individual interviews with healthcare workers were done for practical reasons, to accommodate participants with variable work schedules, and those who were unable to participate in focus groups.

A mapping of objectives (as presented in Fig. 2) to each of the data sources is presented in Table 1.

Data analysis

The data collected from the seasonal reports, questionnaires, focus groups, and individual interviews were analyzed according to two main components: implementation of the MHRP and awareness and application of actions contained in the MHRP concerning heat-related effects and preventive measures (Fig. 2).

Following classification under each objective described (Fig. 2), data were then further categorized according to sub-themes: coordination, services to the population, human resources, material resources, and aspects related to communication.

Initial data analysis consisted of categorizing and coding all the data gathered using NVIVO, version 10 (QSR International, Doncaster, Australia). Coding matrices were then used to retrieve the number of coded items within each subtheme and the year of intervention for all the data (2010 to 2013). Following this analysis, the most frequently occurring elements were identified.

Results

Component A: Implementation

Description of the actions undertaken

Table 2 presents some of the interventions that were mentioned in the seasonal reports and questionnaires and are deployed in the healthcare network and in the community from the period before the summer season to the intervention level during a heat wave.

Progressive implementation of actions stood out as a theme emerging from the data collected from the reports and focus groups with healthcare workers.

Actions deployed in institutions during the active watch, alert, or intervention levels The most frequently reported measure in all data sources is intensified surveillance of signs or symptoms of heat-related illness. Patient visits are more frequent and patients can also be temporarily moved to an air-conditioned common area. Refreshments are also offered to the clientele living in healthcare facilities.

Actions deployed for homecare patients during the active watch, alert, or intervention levels Many healthcare institutions have a large number of homecare patients. Since not all patients are equally vulnerable to heat, the heat plan recommends performing an initial screening to identify the most vulnerable clientele. The seasonal reports and questionnaires confirm that this recommendation is being implemented in many institutions with vulnerable homecare clientele.

Information gathered through the focus group with healthcare workers and in the seasonal reports indicates that

Table 1 Mapping of study objectives to data sources

Data sources	Study objectives				
	Component A: implementation			Component B: document the practice and awareness	
	Objective 1.1 Describe actions that were undertaken	Objective 1.2 Document facilitating factors and challenges	Objective 1.3 Document the suitability of proposed measures	Objective 2.1 Healthcare workers	Objective 2.2 Individuals from vulnerable groups
Seasonal reports from the institutions	X	X	X		
Questionnaire provided to the institutions	X	X	X		
Focus groups of healthcare workers	X	X	X	X	
Individual interviews with healthcare workers	X	X	X	X	
Focus groups of people with schizophrenia and with drug or alcohol dependencies			X		X

Table 2 Examples of actions undertaken by partners in the healthcare network and corresponding level of intervention in the MHRP

Level of intervention	Actions undertaken
Normal In effect Sept. 15 to May 15	<ul style="list-style-type: none"> • Updating of the list of rooms with air conditioning (AC) • Maintenance of ventilation systems and generators in case of power outage • Purchase and installation of ventilators and air conditioners in rooms and hallways
Seasonal watch In effect May 15 to Sept. 15	<ul style="list-style-type: none"> • Communication through different media: television, radio, pamphlets, posters, local newspapers, messages on closed-circuit television monitors (e.g., in the subway), intranet in healthcare institutions, information meetings, etc. • Distribution of information pamphlets produced by Montreal Public Health Department to homecare patients during home visits • Training sessions and reminders to personnel of preventive measures to put in place and signs of heat-related illness • Transmission of the heat response plan to the healthcare workers • Identification of vulnerable clientele and prioritization • Updating the list of available personnel during the summer season to perform check-up telephone calls to the vulnerable population
Active watch In effect following a heat warning by Environment Canada (forecast of temperatures ≥ 30 °C and Humidex ≥ 40)	<ul style="list-style-type: none"> • Transmission in the healthcare network of information from Montreal Public Health concerning levels of the plan that must be implemented • Intensification of surveillance of signs and symptoms of heat-related illness in healthcare institution • During home visits, surveillance of signs and symptoms of heat-related illness and reminder of preventive measures to patients; distribution of water bottles • Closing of windows in the daytime; reopening in the evening • Air conditioning of common areas and opening of these areas during the day, evening, and night for patients in institutions
Alert In effect following a forecast of 3 consecutive days with average maximal temperatures ≥ 33 °C and average minimal temperatures ≥ 20 °C	<ul style="list-style-type: none"> • Conference calls with partners in the healthcare or municipal network and implementation of recommendations given by the Montreal Public Health Department • Dialogue and feedback with partners to discuss implementation of actions • Implementation of the MHRP in each institution • Frequent visits to homecare patients • In institutions, frequent visits to housed patients • Distribution of water, refreshments, lighter meals • Several actions put in place for employees: water distribution, cooling necklaces, common areas with AC, etc. • Monitoring of temperature in work areas, especially in warmer environments (e.g., kitchen, laundry room) • Frequent work breaks for workers in hot, non-air-conditioned environments
Intervention In effect when temperature thresholds have been attained or sanitary indicators are above normal levels	<ul style="list-style-type: none"> • Transfer of patients to common areas with AC • Transfer of vulnerable homecare patients to AC shelters: <ul style="list-style-type: none"> – Planning of transport to the shelter – Care for clientele at the shelter • Daily contact by telephone or home visits to homecare patients. Registry of calls and compilation of questionnaires for home evaluation

the clientele is prioritized based on the presence and severity of underlying medical conditions, as well as environmental characteristics that may increase their vulnerability to heat (e.g., absence of air conditioning at home). A tool based on vulnerabilities provided in the heat plan is used in the prioritization process (Agence de la santé et des services sociaux de Montréal (ASSSM) 2012). Healthcare workers intensify their actions towards this clientele during a heat wave by

performing additional telephone calls or home visits, monitoring for signs and symptoms of heat-related illness during home visits, verifying that patients understand and apply preventive measures (drinking water, spending time in air-conditioned environments, etc.), and evaluating and modifying the home environment (closing blinds on sun-exposed windows, installing ice buckets in front of fans to cool the air, etc.).

Actions deployed to facilitate access to air conditioning

According to the seasonal reports, all healthcare institutions offer at least one common area with air conditioning. The reports also mentioned that an inventory of rooms and areas with functional air conditioning was performed in all institutions prior to the summer season. In the seasonal reports, it was frequently mentioned that preventive measures are put in place to ensure functional air conditioning, even in the event of a power outage.

During the individual interviews, healthcare workers caring for patients at home reported that air conditioning appeared to be more present in institutions than in private dwellings, although they have noticed an increase in the presence of air conditioning in homes since the 2010 heat wave.

Actions deployed for worker protection In the seasonal reports, it was mentioned that several preventive measures are put in place to ensure the safety of healthcare workers during a heat wave, including distribution of refreshments, providing air conditioning in employee areas, allowing frequent work breaks for employees working in hot, non-air-conditioned environments, and monitoring temperature in warmer environments (e.g., kitchen, laundry). In Montreal, workers benefit from an ongoing occupational health and safety program; several of the actions described and recommended in the MHRP are required by provincial regulations.

Facilitating factors and challenges

Facilitating factors According to seasonal reports, the information transmitted to the directors of healthcare institutions during a heat wave is judged to be pertinent and clear (e.g., situational updates, media communiqués, and surveillance data regarding pertinent health indicators). The transmission of information by the Montreal Public Health Department on upcoming meteorological conditions, despite the uncertainty of the long-term meteorological forecasts, allowed a longer period to prepare for the implementation of institutional heat plans and mobilize the necessary personnel.

Both seasonal reports and healthcare workers participating in the focus groups and interviews noted increased efficiency in the process of identifying vulnerable homecare patients since the 2010 heat wave and modifications of the MHRP. The increased efficiency was attributable in part to the lists of vulnerable clientele being updated earlier in the year, before the start of the summer season. Similarly, updating lists of volunteers available to make calls to vulnerable patients earlier in the year was mentioned as an important facilitating factor by the healthcare workers in the focus groups.

Healthcare workers taking part in the focus groups mentioned a better distribution of workload between employees since the 2010 heat wave and modifications of the MHRP; healthcare workers (focus groups and individual interviews) and managers (seasonal reports) also mentioned collaboration

and flexibility of the personnel as a crucial factor in facilitating the implementation of the MHRP.

Challenges Seasonal reports, questionnaires, and healthcare workers participating in focus groups evoked several challenges regarding the prioritization of homecare patients. Updating the lists of vulnerable clientele each year is said to be a time-consuming process. In addition, although the set of criteria used to prioritize homecare patients is identical across institutions (as described in the MHRP Agence de la santé et des services sociaux de Montréal (ASSSM) 2012), its application appears to vary between institutions. In addition, some institutions may have a much larger number of vulnerable individuals to prioritize in their territory.

During the focus groups with healthcare workers in community organizations, many of whom do not have a medical background, the participants mentioned their difficulty in identifying early signs of heat-related illness, particularly among the elderly and people with mental illness, who may have a different perception of heat or show very few exterior signs of heat stress despite significant heat exposure.

In the seasonal reports and questionnaires, managers indicated that ensuring the availability of sufficient personnel was a major challenge since heat waves can strike with very short notice, during holidays or weekends. Personnel must also be added to compensate for the additional workload and to avoid heat exhaustion in employees working in very hot environments.

Suitability of proposed measures

The MHRP includes several preventive measures to put in place in order to reduce heat-related health effects in the general population (drink more water, reduce intensity of outdoor physical exercise, visit a cool or air-conditioned place). Individuals with schizophrenia participating in the focus groups mentioned that many of these measures were now part of their daily routine during hot weather. However, in the individual interviews, healthcare workers performing home visits mentioned that the most vulnerable clientele, often the elderly, would forget to apply preventive measures during hot weather.

Air conditioning may be accessible via air-conditioned shelters that open only during extreme heat waves and are aimed at vulnerable homecare patients identified by the local health administrative unit; public areas with air conditioning (shopping malls, libraries, etc.); and common areas in institutions, supervised apartments, residences for the elderly, etc. According to participants in the focus groups with people with schizophrenia and participants with alcohol or drug dependencies, access to air conditioning via shelters and public areas represents a major challenge. Participants mentioned a number of barriers to benefiting from the air-conditioned shelters targeted specifically towards vulnerable clientele.

First, the shelters require a well-structured environment, supervised by qualified healthcare workers, to offer an air-conditioned environment to very vulnerable people. However, participants of the focus groups (healthcare workers, people with schizophrenia, people with alcohol or drug dependencies) all indicated a need to incorporate a more community-like feel to the shelter (offering simple social activities, for example), in order to encourage people to visit and stay in the shelters. Healthcare workers of the focus groups and individual interviews mentioned that, for a variety of reasons (e.g., limited mobility, difficulty to prepare oneself for outing, and reluctant to be in an unfamiliar environment without activities), individuals at higher risk of heat-related health effects may be more hesitant to leave their homes even if they are suffering from the heat. They also mentioned, together with the individuals from vulnerable populations taking part in the focus groups, that challenges arise when shelters gather people with various medical conditions or mental illness that require a variable intensity of supervision.

Focus group participants with mental illness as well as those with alcohol or drug dependencies, some of whom were homeless, mentioned that access to air conditioning is difficult since their presence is rarely tolerated in public areas. Participants also mentioned the lack of available public places with air conditioning in certain areas. It is not clear whether this reflects a true lack of cool spaces in these areas or incomplete knowledge of the resources available.

Component B: Practice and awareness

Practice and awareness of healthcare professionals

The focus groups and individual interviews revealed that healthcare professionals in hospitals, community organizations, and local health administrative units have a good understanding of the measures to be put in place and their respective roles during a heat wave. All of the preventive measures recommended in the heat response plan were mentioned during the focus groups, and healthcare workers reported taking actions when recommended in the plan.

All of the individual vulnerability factors mentioned in the heat plan were also mentioned in the various data sources, the most frequent being mental illness, social isolation, being elderly, or having cognitive problems that limit the understanding and application of preventive measures. Other risk factors that were mentioned include Alzheimer's disease, cardiac disease, asthma, and living in areas with no green spaces or having no public areas with air conditioning. There were also several mentions of the effect of cumulative vulnerability factors on the general vulnerability of an individual towards heat.

Also, it was mentioned in seasonal reports that prevention campaigns might not reach newly arrived immigrants with communication difficulties in French or English, who would thus be at increased risk. Nonetheless, products of the

communication campaign were deemed useful by the healthcare workers, who mentioned they used the information pamphlets to illustrate general preventive measures to their patients during homecare visits and that these could be displayed in the patient's home as a reminder of measures to be applied.

Practice and awareness of individuals from vulnerable population groups

The focus group of people with schizophrenia revealed that the participants perceived extreme heat as being a threat to their health and requiring individual preventive measures. The majority of participants in this focus group reported drinking more water and going to air-conditioned places as the main preventive measures that they undertook during a heat wave. However, within the focus group with people having alcohol or drug dependencies and who were sometimes homeless, extreme heat was not perceived as being an important threat to their health, compared to other daily issues they were facing.

Patients with schizophrenia or drug or alcohol dependencies participating in the focus groups mentioned acquiring information on heat-related health effects and preventive measures via television or radio and through pamphlets and posters from Montreal Public Health, local newspapers, and free newspapers distributed in the subway system. Other sources of information mentioned by these two groups included community centres, hospitals, specialized clinics, community organizations, institutions, local health administrative unit, their healthcare workers, doctors, family, and friends.

Discussion

Our evaluation demonstrated that a diversity of preventive measures is undertaken by a variety of actors in the health network during the summer period, as directed in the plan. The MHRP appears to be rolled out in a graduated fashion consistent with an approach based on preventing health impacts and adapting intensity of intervention to the level of risk. This rollout is facilitated by fluid communication between actors, timely information, and the adaptability of the plan.

Participants in the focus groups also proposed measures that may prove to be useful complements to the measures already in place, for example, increasing access to air conditioning in environments that are already visited daily by people who may be more vulnerable to heat (e.g., community organizations offering daily activities).

Our results may have implications for future iterations of the heat plan. First, it was mentioned that difficulties can arise in identifying heat-related symptoms, especially in people having an altered perception of heat or for healthcare workers who do not have a medical background. Emphasis should therefore be placed on preventive measures to avoid reaching

the point when symptoms of heat-related stress can be perceived in the clientele. Suggested preventive measures include classic measures to be reinforced by all healthcare workers offering homecare to patients (suggest to drink more water, visit an air-conditioned environment, etc.), but can also include other actions, for example, daily visits in supervised apartments without air conditioning to make sure occupants are healthy and encourage them to visit the common areas with air conditioning. This may also suggest a need for more training of non-medical personnel, particularly those working with vulnerable clientele in a community setting.

Our results suggest that individuals from vulnerable populations that have been specifically targeted with public health messaging campaigns (e.g., the elderly or populations with mental illness) apply several of the preventive measures that are recommended. Although we cautiously assume that knowledge and awareness of vulnerable people towards heat could be attributed to measures included in the heat plan, further research would be needed to confirm this.

To our knowledge, this is one of the first reports of an implementation evaluation of a local heat plan (Kunst and Britstra 2013) that focuses on the entire implementation of the plan, from healthcare institutions and community organizations to the population that benefit from the heat plan (Toloo et al. 2013). An earlier study undertaken in Montreal specifically evaluated the implementation of health education messaging, but did not look at the spectrum of actions recommended in the heat plan (Gosselin et al. 2009). Similarly, a 2011 report on the 2010 heat wave looked specifically at the implementation of the heat plan during a heat wave, but did not provide a global portrait of preventive measures in place during the entire summer season (Roy et al. 2011). However, it also highlighted the rapid mobilization of resources, the adequate flow of clear information, the good coordination and collaboration of the partners, and the adequate response of stakeholders in the field during the heat wave. Benmarhnia et al. (2016) used a quasi-experimental method to estimate the causal effects associated with initial implementation of the MHRP. Results showed a reduction of total mortality on hot days between 2004 and 2007 linked to implementation of the plan, with greater benefit for elderly people and people living in low socio-economic status neighbourhoods. The results of the current study are complementary to previous research and show that while the plan may reduce the number of deaths on hot days, there remain challenges to the implementation of the MHRP actions.

This is the first study to specifically address the measures targeted towards vulnerable populations. Defining and targeting vulnerable populations are essential components in a large majority of heat plans (Lowe et al. 2011), and our study presents encouraging results about this practice.

For the current evaluation study, we chose to integrate several different sources of information and we also targeted a

variety of stakeholders. An approach based on multiple qualitative approaches may have several advantages, notably the complementarity of the information gathered from the various sources (Toloo et al. 2013). In the current study, the seasonal reports provided a general portrait of the measures that were implemented in preparation for or during a heat wave as well as insight into the general management of a heat wave in an institution and interactions between partners in the healthcare network.

Focus groups with healthcare workers and vulnerable populations and individual interviews were also added to answer new objectives and allowed a different perspective of the issues dealt with in the reports. Thus, complementary information concerning the deployment of measures and practice and awareness of healthcare professionals and vulnerable people was gathered.

Although our approach allowed us to broaden the scope of our evaluation, a methodology based on multiple qualitative data sources also has limitations. First, although several focus groups and individual interviews were performed, the amount of information gathered through that source remains lesser than that obtained through the seasonal reports. This explains why focus groups and individual interviews were used only to gain complementary information concerning actions undertaken and facilitating factors or challenges during implementation. The relative weighting of information obtained through the seasonal reports and the focus groups is an additional challenge. While the seasonal reports provide a census of all institutions in the territory of interest, the focus groups and interviews are based on a non-random sample. It is difficult to know to what extent this may have an impact on the results of our evaluation.

Conclusion

The methodology proposed in this evaluation of the Montreal heat response plan is an approach that could be used for future evaluations of the plan or for the evaluation of heat response plans in other cities. Identification of actions undertaken, challenges in the implementation of the heat plan or information pertaining to the feasibility of proposed measures, or the practice of healthcare workers and the vulnerable population were facilitated by the use of complementary sources of information. The evaluation also allowed us to identify aspects that could be improved in the heat plan, with the main objective being to maximize benefit among vulnerable populations. Our study is particularly relevant in light of recent recommendations by the WHO (World Health Organization (WHO) 2015) and others (White-Newsome et al. 2014) to provide evidence regarding the implementation of heat action plans to promote health. Our qualitative implementation evaluation study is a necessary complement to studies that quantitatively assess the

health effects of heat plans; together, they provide a more complete portrait of the effectiveness of heat action policies.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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