

## Interventional pain physician beliefs on climate change: A Spine Intervention Society (SIS) survey

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### ABSTRACT

**Summary of background data:** Although evaluated within other specialties, physicians' beliefs towards climate change and human health have not been described within Interventional Pain Medicine (IPM). Understanding belief systems is essential for developing solutions to build sustainable practices.

**Objectives:** Assess beliefs toward climate change within the field of IPM.

**Methods:** Spine Intervention Society (SIS) members were invited to participate in an anonymous RedCap survey by email, social media, and advertisement at the 2022 SIS Annual Meeting. Descriptive statistics were calculated, and associations were estimated using Chi-Square (significance:  $p < 0.05$ ).

**Results:** One hundred and seventy-five participants responded to the survey. Participants most often identified as white (66 %; 95 % CI 57–73 %), male (78 %; 95 % CI 71–84 %), and from the United States (US) (76 %; CI 95 % 58–72 %), with 87 % ( $n = 123/141$ ; 95 % CI 82–93 %) agreeing that climate change is happening (agree or strongly agree). While 78 % (95 % CI 80–92 %) agree that climate change and sustainability are important to them, only 47 % (95 % CI 34–51 %) agree that these are important to their patients. Those beliefs did not differ by age or geographical area ( $p > 0.05$ ). However, physicians in non-leadership positions are more likely to disagree or strongly disagree that climate change is important to them ( $\chi^2(2) = 15.98$ ;  $p < 0.05$ ), to their patients ( $\chi^2(2) = 17.21$ ;  $p < 0.05$ ), or that societies should advocate for climate policies ( $\chi^2(2) = 9.19$ ;  $p < 0.05$ ). Non-US physicians were more likely to believe that physicians have responsibilities to bring awareness to the health effects of climate change ( $\chi^2(2) = 6.58$ ;  $p < 0.05$ ) and to agree that climate change is important to their patients ( $\chi^2(2) = 10.50$ ;  $p < 0.05$ ).

**Discussion/conclusion:** Understanding specialty-specific physician views on climate change is essential for developing solutions to reduce the carbon footprint of medical practice and improve sustainability. The majority of SIS members believe that climate change is happening. Non-US physicians and physician-leaders are more likely to believe that climate change impacts their patients and that societies should advocate for climate policies.

### 1. Introduction

The impact of climate change on human health is profound and far-reaching. Extensive research has demonstrated that various factors, such as rising global temperatures, extreme weather events, pollution, and the emergence of zoonotic viruses, are related to human activity, rising carbon emissions, and climate change [1]. These phenomena have direct and indirect consequences for human health, which is a matter of great

concern for public health professionals and individuals alike [2]. Despite the critical role the healthcare sector plays in addressing human health, it paradoxically stands as a significant contributor to global carbon emissions [3]. This highlights the urgent need for strategies that not only enable adaptation to climate change but also safeguard human health across all medical disciplines, including Interventional Pain Medicine (IPM) [4].

The impact of climate change on patients with chronic pain is an

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emerging area of research. Pain is a multifaceted process influenced by physiological, psychological, and environmental factors, as per the biopsychosocial model [5]. Climate change-related health events have the potential to influence these inputs and modify disease course, and therefore, treatment paradigms. For example, the rapid spread of infectious diseases like Lyme disease and Zika virus is concerning due to the increased likelihood of developing chronic musculoskeletal pain, which represents an indirect physiological change [6]. Other data suggest that extreme weather conditions can directly exacerbate musculoskeletal disorders such as osteoarthritis [7,8]. Climate change-related weather events negatively affect the utilization of key treatments for numerous pain conditions such as physical therapy [9,10]. From a psychological perspective, climate change may parallel traumatic stress mechanisms, leading to exacerbation of mental health disorders and chronic pain [11]. On a population level, people with chronic pain are more likely to have a disability, limited access to resources, and disproportionately experience the effects of climate change (Fig. 1) [12, 13].

In the context of climate change, collaboration between physicians and public health officials is essential for effectively treating patients with chronic pain in connection with developing more optimal environmental sustainability practices. Several studies conducted by physician organizations have been initiated as the first steps toward achieving this goal. Existing research on physician beliefs toward climate change has uncovered important insights. For one, the majority of physicians recognize the reality of climate change and acknowledge its impact on human health. However, variations in attitudes exist based on factors such as medical specialty, geographic location, and personal beliefs [2]. While many physicians express a desire to participate in climate-related activities and adopt sustainable practices, barriers such as limited knowledge, time constraints, and perceived lack of support hinder their involvement. Currently, there are no available data specific to the beliefs of IPM physicians in this regard.

This study aimed to evaluate beliefs toward climate change and its perceived interaction with human health, specifically in the field of IPM. Assessing physician attitudes in this context is vital for various reasons. It represents the first critical step in understanding what knowledge and behavior gaps exist. Such information then allows the development of innovative solutions to address climate-related health challenges.

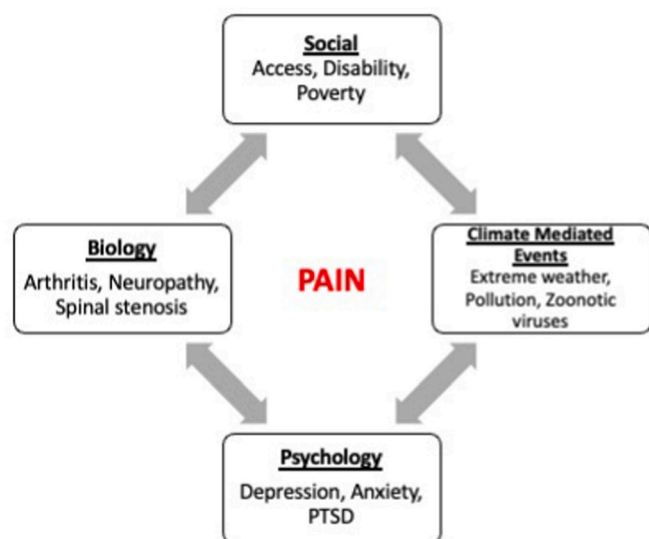


Fig. 1. Domains of the biopsychosocial model of pain may be modulated by climate change-related events.

## 2. Materials & methods

### 2.1. Survey design

A comprehensive English-language survey on climate change and waste practices was designed. This four-part survey addressed the following domains: demographics (Part 1: 10 questions), climate beliefs (Part 2: 36 questions), waste management (Part 3: 33 questions), and interventions/education (Part 4: 4 questions). The present study addresses data collected in Parts 1 and 2. The questions covered in Part 2 were adapted from Kotcher et al., 2019 [2], who surveyed members of twelve health professional organizations worldwide to assess views about climate change as a human health issue. The questions covered in Part 3 were adapted from Petre et al., 2019 [14]. Three physicians with formal training in evidence-based medicine adapted the survey (AF, GD, and ZM). IRB-exempt status was obtained at Washington University in Saint Louis. A copy of the questionnaire is provided in the Appendix.

### 2.2. Dissemination & participant eligibility

Spine Intervention Society (SIS) members were invited to participate by email, social media, conference application, and in-person advertisement at the 2022 SIS Annual Meeting in Vancouver, Canada. SIS has since changed its name to the International Pain and Spine Intervention Society (IPSIS), effective September 11, 2023. IPSIS membership comprises 3500 physicians in 55 countries [15]. All physician members were eligible to participate regardless of seniority, level of training, or country of origin. Non-physician members and conference attendees, such as organization staff and vendors, were ineligible and screened out in Part I. The survey was open from September 14, 2022, to December 30, 2022.

### 2.3. Data collection

Study data were collected and managed using REDCap electronic data capture tools hosted at Washington University in Saint Louis [16, 17]. REDCap (Research Electronic Data Capture) is a secure, web-based software platform designed to support data capture for research studies, providing 1) an intuitive interface for validated data capture; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for data integration and interoperability with external sources. Participants were not required to answer each question to progress through the survey.

### 2.4. Statistical analysis

Data were exported into SPSS (Statistical Package for Social Sciences) for analysis (IBM Corp, Version 28.0., Armonk, NY). Simple frequency distributions were calculated for all variables associated with the relevant question. Chi-Square was used to compare observed results with expected results (significance:  $p < 0.05$ ) by author JS. Multivariate analysis (e.g. logistic regression) was not feasible given the small number of observations in some IVs and condition groups. Conducting such an analysis would result in unstable betas and large standard errors, which would make the model uninterpretable. We therefore opted for bivariate analysis, which limits our ability to control for factors and is a limitation of the analysis.

## 3. Results

### 3.1. Description of participants

A total of 175 participants responded to the survey, with 30 % ( $n = 47/159$ ; 95 % CI 22–37 %) being 31–40 years old. Participants most often identified as white (66 %,  $n = 104/158$ ; 95 % CI 57–73 %), male (78 %,  $n = 125/159$ ; 95 % CI 71–84 %) and practicing in the United

States (US) (76 %,  $n = 115/175$ ; 95 % CI 58–72 %). Eighty-nine percent ( $n = 140/158$ ; 95 % CI 82–93 %) of participants identified their role as staff physician/attending, with base training in Physical Medicine and Rehabilitation (PM&R) (55 %,  $n = 88/159$ ; 95 % CI 47–63 %) and Anesthesiology (35 %,  $n = 56/159$ ; 95 % CI 27–43 %) as the two predominant fields. Fifty-five percent ( $n = 85/159$ ; 95 % CI 45–61 %) of participants reported working in private practice (23 %,  $n = 41/175$ ; 95 % CI 17–30 %) with either less than three physicians; (31 %,  $n = 55/175$ ; 95 % CI 24–38 %) working in practices with three or more physicians. Approximately 39 % ( $n = 68/175$ ; 95 % CI 31–46 %) of respondents reported having no leadership role within their organization (see Table 1). An exact responder rate could not be calculated.

### 3.2. Climate beliefs

Eighty-seven percent ( $n = 123/141$ ; 95 % CI 80–92 %) responded

**Table 1**  
Demographics of survey respondents.

Sample Characteristics	% (95 % CI)
Age Range	
21–30 years	1 % (0.2%–4%)
31–40 years	30 % (22%–37 %)
41–50 years	25 % (18%–32 %)
51–60 years	21 % (16%–29 %)
61–70 years	21 % (16%–29 %)
71–80 years	2 % (0.4%–5%)
Gender	
Female	18 % (12%–24 %)
Male	78 % (71%–85 %)
Prefer not to say	4 % (1%–8%)
Race/Ethnicity	
White or Caucasian	66 % (58%–73 %)
Black or African American	1 % (0.2%–4%)
Asian	13 % (8%–20 %)
American Indian or Alaska Native	1 % (0.02%–3%)
Multiracial	6 % (3%–11 %)
Some other race	3 % (1%–7%)
Prefer not to say	10 % (6%–16 %)
Location of Medical Practice	
US	76 % (68%–82 %)
Not in the US	24 % (18%–32 %)
Healthcare Setting	
Private Practice only	53 % (45%–61 %)
Other	47 % (39%–55 %)
Primary area of training	
Physical Medicine & Rehabilitation (PM&R)	55 % (47%–63 %)
Anesthesiology	35 % (28%–43 %)
Other	10 % (6%–15 %)
Current Role	
Staff physician/attending	89 % (83%–93 %)
Fellow	4 % (1%–8%)
Resident	5 % (2%–10 %)
Other	2 % (0.7%–6%)
Leadership Position	
Non- Leader	39 % (32%–46 %)
Leader	61 % (53%–68 %)

positively that climate change is happening (agree or strongly agree), as shown in Table 2. While 78 % ( $n = 109/140$ ; 95 % CI 80–92 %) responded positively that climate change and sustainability are important to them (agree or strongly agree), only 48 % ( $n = 67/141$ ; 95 % CI 39–56 %) believe that these are important to their patients (agree or strongly agree). Those beliefs did not differ by age or geographical area ( $p > 0.05$ ). However, physicians in non-leadership positions were more likely to disagree or strongly disagree that climate change is important to them ( $\chi^2(2) = 15.98$ ;  $p < 0.05$ ), to their patients ( $\chi^2(2) = 17.21$ ;  $p < 0.05$ ), and that climate change is happening ( $\chi^2(2) = 7.57$ ;  $p < 0.05$ ). Additionally, physicians in non-leadership positions are more likely to disagree or strongly disagree that there is an interaction between human health and climate change ( $\chi^2(2) = 9.53$ ;  $p < 0.05$ ), that professional societies should advocate for climate policies ( $\chi^2(2) = 9.19$ ;  $p < 0.05$ ), and that professional societies should advocate for increased investments in health effects of climate change and sustainability ( $\chi^2(2) = 7.07$ ;  $p < 0.05$ ).

### 3.3. Effects of climate change on physicians and their patients

Physicians reported the top three health threats posed by climate change as being: 1) illness due to reduced air quality (36 %,  $n = 50/140$ ; 95 % CI 27–44 %), 2) physical or mental harm from forest fires or brush fires (35 %,  $n = 49/141$ ; 95 % CI 26–43 %), and 3) disruptions to healthcare services for people with chronic conditions during extreme weather events (35 %,  $n = 48/139$ ; 95 % CI 26–43 %). See Fig. 2.

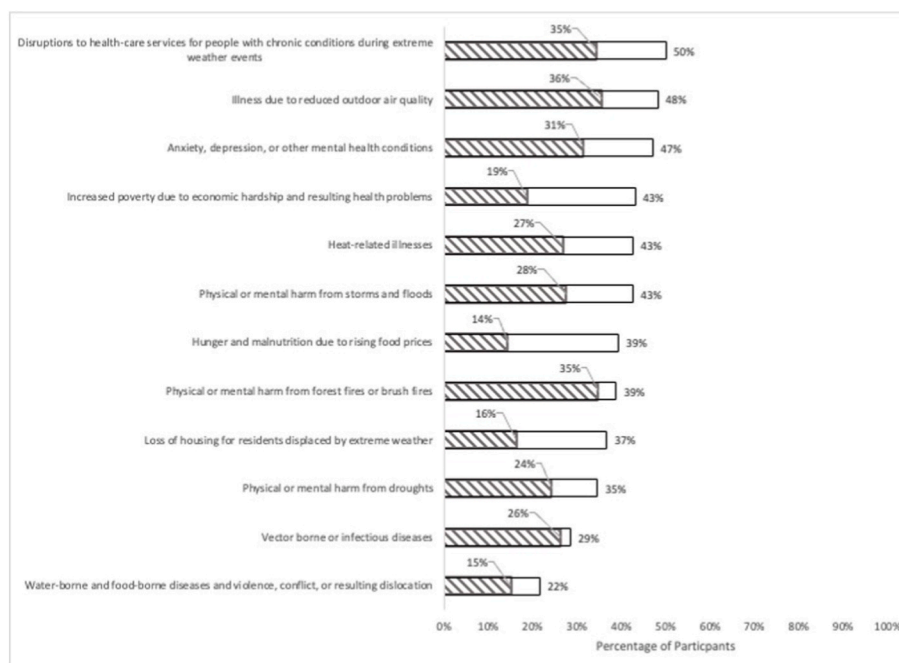
Physicians perceived that their patients experienced the following top three climate threats: 1) disruptions to healthcare services for people with chronic conditions (50 %,  $n = 70/140$ ; 95 % CI 41–58 %), 2) illness due to reduced outdoor air quality (48 %,  $n = 68/141$ ; 95 % CI 39–56 %), 3) anxiety, depression, or other mental health conditions (47 %,  $n = 66/140$ ; 95 % CI 38–55 %). Of the surveyed physicians, 43 % ( $n = 59/137$ ; 95 % CI 34–51 %) perceive that climate change has impacted their patients through economic hardship (resulting in health problems) more so than themselves or their families). A majority of physicians surveyed do not perceive themselves or their patients as having been impacted by vector-borne diseases as a result of climate change, 26 % ( $n = 37/140$ ; 95 % CI 19–34 %) and 29 % ( $n = 39/139$ ; 95 % CI 20–36 %), respectively.

### 3.4. Geographical associations

Non-US physicians were more likely to believe that physicians have responsibilities to bring awareness to the health effects of climate change ( $\chi^2(2) = 6.58$ ;  $p < 0.05$ ) and to agree that climate change is important to their patients ( $\chi^2(2) = 10.50$ ;  $p < 0.05$ ). Comparisons by state or region were not possible due to the small sample size.

**Table 2**  
Climate change beliefs in positive respondents.

Climate Change Beliefs	% (95 % CI)
I believe climate change is happening	87 % (80%–92 %)
Climate change and sustainability are very important to me personally	78 % (70%–84 %)
Climate change and sustainability are very important to my patients	48 % (39%–56 %)
There is an interaction between human health and climate change	77 % (69%–84 %)
Physicians have a responsibility to bring the health effects of climate change to the public	59 % (50%–67 %)
Professional societies should develop policy statements on health and climate change	62 % (53%–70 %)
Professional societies should advocate for increased investments in health effects of climate change and sustainability	67 % (59%–75 %)



**Fig. 2.** Physician-reported climate change effects on themselves and their patients (agree and strongly agree). The solid bar designates “Has affected my patients,” and the striped bar designates “Has personally affected me and my family.”

### 3.5. Physician perspectives

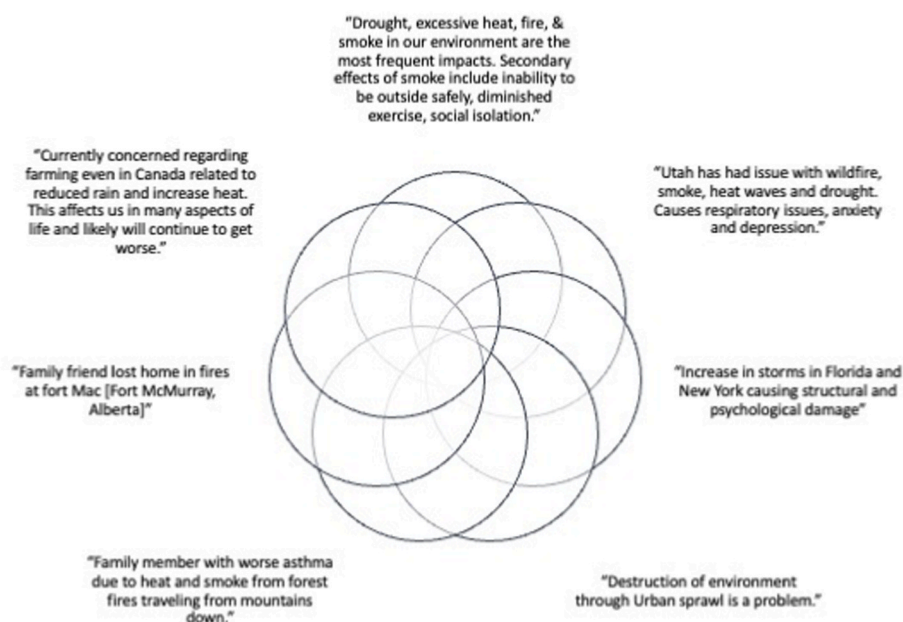
Survey respondents were asked to specify if climate change had impacted them, their families, or patients in other ways by providing a free-text response. Please see Fig. 3.

## 4. Discussion

This survey of the SIS physician members revealed a significant and positive belief among participants that climate change is indeed occurring, with 87 % of respondents expressing this viewpoint and 77 % endorsing a relationship between human health and climate change.

These results align with other large-scale physician surveys. A recent study by Kotcher et al. encompassing twelve health professional organizations from various parts of the world reported that 95 % of physicians shared the belief that climate change is happening. Building upon the existing body of knowledge, our study contributes new evidence specifically focused on the views of IPM physicians regarding climate change, enabling a more nuanced understanding of this complex issue to generate solutions to serve our unique patient population.

Survey respondents diverged from other large professional organizations in how members ranked the relative importance of climate-related health threats. SIS physicians were personally concerned with illness due to reduced air quality (36 %), harm from forest fires or brush



**Fig. 3.** Physician-reported free-text inputs on other ways climate change has impacted them, their families, or patients.



fires (35 %), and disruptions to healthcare services for people with chronic conditions during extreme weather events (35 %). While these concerns were shared by physicians surveyed by Kotcher (where reported data do not always distinguish between personal risk, community risk, and patient risk), a larger proportion of respondents identified those same domains as areas of concern (65 %, 63 %, and 43 %, respectively). Of note, when SIS physicians were asked about the perceived climate health risk to their patients, there was a more significant concern for patients compared to themselves, in particular with regards to disruptions to healthcare services (50 %), illness due to reduced outdoor air quality (48 %), and exacerbation of anxiety, depression, or other mental health conditions (47 %). Of the surveyed physicians, 43 % also perceived that climate change has impacted their patients through economic hardship (resulting in health problems) more so than themselves or their families. Our results suggest that patients' mental health, disability, and care access are perceived as more considerable risks by IPM physicians. We hypothesize that IPM physicians are more likely to encounter patients with mental illness, disability, and chronic conditions than the general population studied by Kotcher et al. by the nature of treating patients with chronic pain.

Despite reporting a higher perception of risk in patients compared to themselves, survey respondents believed that patients cared less about climate change compared to them (77 % versus 47 %, respectively). However, this view conflicts with our current understanding of patient perspectives, which supports that patients demonstrate both awareness and concern regarding the connection between health and climate change. A recent survey conducted in Germany revealed that the population acknowledges the existence of human-induced climate change (85 %) and recognizes its impact on human health (83 %) [18]. Furthermore, a small qualitative study involving hospitalized German inpatients showcased statements from 25 patients regarding the effects of climate change on their personal health [19]. Another study encompassing patients from the United States and Canada identified climate change as a contributing factor to various health-related problems such as respiratory issues, heat-related ailments, cancer, and infectious diseases [20]. However, no existing study has examined the perspectives of patients with chronic pain disorders. This cognitive dissonance on the part of physicians may be overcome by education and through incorporating patient perspectives into future research. Additionally, other authors have suggested that climate change be considered a new core concept in the patient-centered care model [19].

The responsibility of physicians and their organizations to participate in climate change advocacy needs to be clarified. In our study, 67 % of respondents reported that professional societies should advocate for climate change initiatives, but only 59 % felt that physicians have an individual responsibility to bring this to the public. In Kotcher et al., physicians reported a responsibility to educate the public about the problem and reported that 86 % of participants said that physicians have a responsibility to bring the health effects of climate change to the public and that 89 % felt that health professionals should be involved in national advocacy (89 %) [2]. In our study, it was also observed that non-US physicians were more inclined to believe that physicians are responsible for raising awareness about climate change's health effects and recognizing its importance to their patients. Additionally, our findings suggest that physicians in leadership positions were more likely to believe that societies should advocate for climate policies.

Nevertheless, existing data support the crucial role of individual physicians and societal advocacy in addressing the health effects of climate change. A recent case study examining a physician-led clean-air advocacy group that successfully lobbied against leaded aviation gasoline offers a valuable framework for clinicians and advocates to drive change within their communities [21]. In terms of medical society prioritization, a study focusing on US physician organizations argued that high-performing organizations could serve as guides for others to mitigate and adapt to the climate emergency effectively. The study revealed that 45 % of US medical organizations incorporated at least one metric

referencing climate change. However, only 20 % had position statements or policies related to climate change, 11 % had committees or task forces specifically addressing climate change, 21 % included recommendations for green practices, and 45 % featured articles in official society publications addressing climate change [22]. These findings highlight the potential for medical societies to enhance their efforts in addressing climate change and provide insights for improving climate-related initiatives within healthcare systems.

The present study is subject to certain limitations. Firstly, it was not designed with the power necessary to conduct extensive subgroup analysis. Additionally, the study had a relatively low number of participants. However, it is worth noting that the responder rate falls within the range observed in other studies conducted within the organization. For instance, the spine complications survey obtained responses from 314 individuals [23], while the Covid survey had 195 participants [24]. The Kotcher et al. study reported responder rates ranging from 0.4 % to 18 %, depending on the specific medical organization surveyed [2].

## 5. Conclusion

In conclusion, the findings of our study highlight the concerns and beliefs among SIS physicians in 2022 regarding climate change and its impact on their patients. Non-US physicians and physician-leaders exhibited a stronger inclination towards recognizing the influence of climate change on patient health and advocating for climate policies. We strongly advocate for placing physicians and their patients at the forefront of climate conversations and policy development. Understanding the specific views of physicians in different specialties, such as IPM, is crucial for devising sustainable solutions and effectively addressing the needs of the patient population that we serve.

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## 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.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.inpm.2023.100287>.

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