

Household Pharmaceutical Waste Disposal in Beijing: Knowledge, Practice & Attitude

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Abstract: Attention has been paid for decades to unused and expired medications amid the environmental risk of improper disposal. The situation in emerging populous countries like China, with mounting drug consumption but largely unregulated household waste disposal, should be closely examined. This paper looked at residents' knowledge, practice and attitude regarding household pharmaceutical waste disposal in Beijing through a questionnaire survey. Findings indicated that the majority in this capital were conscious of the environmental risk, active with following disposal-regulating policies or campaigns, but failed in practice to dispose of drug waste scientifically. As the public prioritized convenience, admitted limited awareness and emphasized governmental responsibility, efforts should be concentrated to make recycling infrastructures more accessible, publicity more effective, and policy making more proactive.

Keywords: Pharmaceutical Waste; Drug Disposal; Recycling

Introduction

According to IQVIA Institute's Global Medicine Spending and Usage Trends report 2020^[1], the pre-COVID decade has seen a compound annual growth rate of 3%-4% in global use of medicines, with the large-population developing (so-called 'pharmerging') countries consistently outpacing developed ones; China is the largest pharmerging market so far, ranking only second to the US in world's medicine spending of 2019. China's vast medicine use scale is largely attributed to its significant expansion of access to health care and medicine service. Pharmacies in China rose by 21.4% between 2017 and 2020, 6.7% annually^[2]. What is more, China is holding huge potential of increase in medicine use as its daily dose per capita is still lower than that in the developed world^[1]. The mounting spending and use of drugs renders noticeable the issues that appear after the purchase, one of which focuses on how to dispose of unused and expired pills.

Many various measures have been created to minimize the negative impact that medicine wastes bring on the environment and human health^[3]. Countries like Sweden and France have nationwide recycling regime, and the European Union has placed an obligation on member states to ensure appropriate collection^[4], while those like the United States and Canada have no unified national regulation but authorize states or provinces to make and implement localized policies. Pharmacies are encouraged or required by many countries to play a key role in collecting unwanted drugs from consumers and then send to incineration or humanitarian redistribution. Some measures straightforwardly motivate or regulate citizens' behaviors, for example rewarding active return and punishing unauthorized disposal. However, these measures might have different results in different regions.

Developed countries vary in the proportion of scientific disposal. In Sweden, 85% of the people know the correct method is to return unused drugs to the pharmacy, and most of them have followed this way^[5]. Sweden's pharmacy-centered recycling system was introduced in 1970s and education on drug disposal is proper and widespread. In many other European

countries, however, the proportions are much lower, for example 30% in Poland^[6], 28% in Ireland^[4], 22% in UK^[7] and 15% in Serbia^[8]. Surveys in New Zealand show concerning situations, too, suggesting that only 17% of New Zealanders know the take-back service offered by pharmacies^[9]. These outcomes signify that even people born with most progressive environmental ideology context do not take the most environment-friendly option naturally, so the impact of publicity and education should not be overestimated. The rates in developing countries are prevalently lower, with a narrow range from only 4% in Saudi Arabia^[7], 6% in urban India^[10], 7% in urban Afghanistan^[11] to 15% in Ethiopia^[12]. With governments paying less focus onto environmental issues, people in developing countries are less likely to consider properly dispensing medicines an important action or notice the harm of improperly disposed of medicine to the environment and sometimes to people's health. However, the consequence of ignoring this issue may be more serious in developing countries than developed ones because of the larger population size and yet weaker environmental infrastructure.

China has not put into effect any national mandatory regulation on drug recycling. While a few cities like Shanghai and Guangzhou have developed local recycling regime based on household garbage sorting and pharmaceutical industries respectively, Beijing as the capital city is still lacking city-wide policy making on this issue. It is thus interesting to examine the public consciousness of the link between drug wastes and environment in this hub of political, economic and cultural elites. People in some middle-level cities, according to a few papers^[13,14], knew little about the environmental and health risk of unscientific disposal. Therefore, this empirical study was planned with the aim to report some statistics from the public in China's capital city about residents' attitude, knowledge, and practice toward the disposal of unwanted and expired medicines.

Method

This paper used cross-sectional questionnaire-based survey to study Beijing residents' practices and opinions. The questionnaire was collected during January, 2022 and disseminated across Beijing city. Each participant was informed in the questionnaire that their personal information will not be leaked and all questionnaire results will only be used as research data, so those who choose to participate are deemed informed and consented. Participants were randomly selected with convenience sampling approach, all living in Beijing. Finally, 264 questionnaires were received, of which 223 were valid. The effective rate of questionnaire was 84.5%. The questionnaire consists of 24 questions, divided into attitudes of medicine recycling, understanding of medicine recycling and willingness to obtain knowledge related with medicine recycling. Microsoft Excel was used to analyze data. Considering the type of data, descriptive statistics was the main approach of analysis. To be specific, the percentages and frequency were analyzed and displayed by classification, graphing, and computational calculation.

Results

In the 223 valid respondents (Table 1), 37.2% are male and 62.8% female. 41.7% of the respondents are aged 40-59 years old and 35.0% 20-39 years old, while 18.8% are under 20 years old and only 4.5% in their 60s and above. College degree holders altogether account for 65.9% of the respondents, and another 27.3% obtained high school or junior/vocational college diploma. Overall the respondents are predominantly covered by the Internet (87.9%), with merely 3.1% using traditional print or broadcast media as the primary information sources.

Medicines consumption and disposal behavior

64.6% of people claimed that they purchased medicines just as much as they needed, and 22.0% of people bought drugs more than their demand. Another 11.2% of people did not have fixed consumptive habit. As to home inventory of expired and unwanted medicines, only 9.9% of the respondents said "none". Rather, 54.7% admitted "a lot" or "a few", and 31.8% "little", making up an 86.5% majority to be respondents for further questions on medicines disposal.

In terms of frequency of disposal, 6.7% of total respondents cleaned their home inventories at least seasonally, while the remaining 79.8% did it no more than once half a year. The predominant way of disposal (Figure 1) was to throw with

domestic garbage or pour into stools, covering 65.9% of total respondents. Sorting and recycling as special waste was the second most popular way with 19.7% taking it. The remaining 0.9% preferred to give back the drugs to the pharmacy.

The most recognized answer to why to dispose in the reported way was convenience, accepted by 44.4% of total respondents (Figure 2). 27.8 % reportedly used to do it out of habit. Only 11.2% took science as the prime reason. Correspondingly, 30.0% of total respondents believed their ways of disposal have no environmental impact. Another 33.6% saw their ways mildly negative and 10.8% consider them hugely negative. Only 12.1% thought their ways would bring benefit to the environment.

Knowledge and awareness related to medicines disposal

26.0% of total respondents stated that they have ever obtained information of disposing medicine from websites, videoslips, social media or other online sources. 10.8% have heard it from others around them. Television and radio have spread the information over 9.8% of the sample population. Nevertheless, still 63.2% said they have never seen or heard anything about disposing medicine.

Almost half of the surveyed people (48.9%) asserted that there is no medicine-recycling site around their neighborhood. 48.0% were unsure whether there was any such site nearby. Only a few (3.1%) could confirm the existence and identify the location, and they mostly have utilized those sites as the ways of disposal they report signify. The city's policies, publicities and campaigns for disposing medicines were only known to 9.0% of its people.

Attitude related to medicines disposal

65.0% of the people were willing to actively participate in recycling medicines, and another 10.8% preferred to do it casually. 9.4% are unwilling, with half against it and half not caring at all. 14.8% have no clear attitude. Most people (77.6%) agreed that it is necessary for the city to advocate medicine recycling. For them, environment protection is the most concerning and resource reuse the second. 6.2% held opposite opinion and 16.2% was unclear. 46.2% of the people thought the government is the most significant bearers for medicine recycling policy, while pharmaceutical and waste-recycling industry were named by 25.6% and 15.2% respectively (Figure 3). 13% in total assert pharmacy and hospital should take the most responsibility.

75.3% of inhabitants preferred to dispose the drugs by themselves, while the remaining considered collecting from home doorstep better. 45.3% of the people thought community garbage collection zone is the best place to build a drug recycle station, 33.6% did community service organization, 14.8% pharmacy and 4.0% hospital.

74.0% of people thought the reward recycling policy is good, but in terms of limiting the number of drugs they bought, the majority is smaller (59.6%). 84.8% of the inhabitants were willing to know more about the recycling of the expired medicine, and 15.2% held opposite perspective.

Table 1 Demographics of Sample Population

	Total	N=223	100%
<i>Sex</i>			
Male		83	37.2%
Female		140	62.8%
<i>Age</i>			
Under 20 years old		42	18.8%
Between 20 and 39		78	35.0%
Between 40 and 59		93	41.7%
60 years old and above		10	4.5%
<i>Education</i>			
Middle school and below		15	6.7%
High school		41	18.4%

Vocational college	20	9.0%
Undergraduate	105	47.1%
Postgraduate	42	18.8%
<i>Primary Media Channel</i>		
Internet	196	87.9%
TV&broadcast	7	3.1%
Print media	2	0.9%
Public advertisement	1	0.4%
Others	17	7.6%



Figure 1 Ways of Disposal

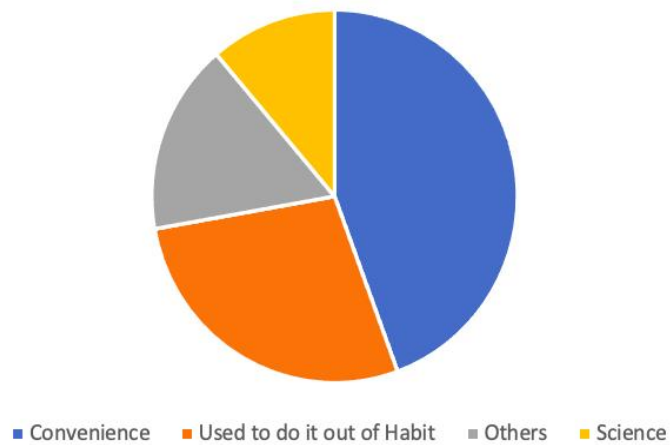


Figure 2 Reasons of Disposal Way Selection

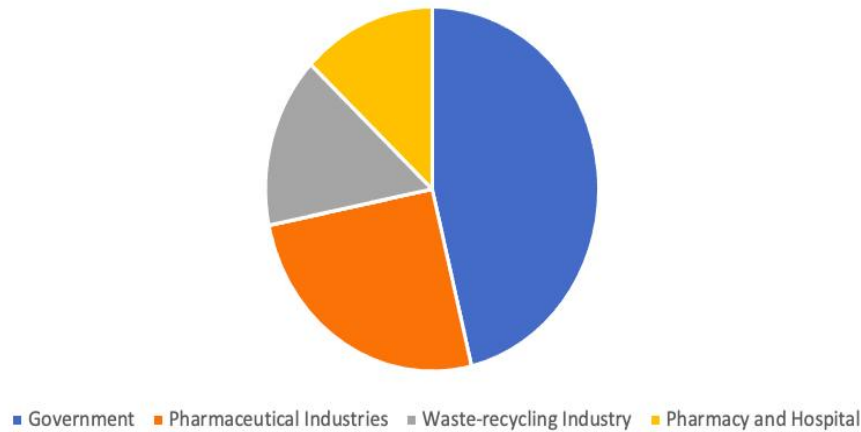


Figure 3 Who Should Take First Responsibility in Drug Recycling

Discussion

A core question to answer in this paper is to what extent people in Beijing know the environmental consequence of their medicine-disposing behaviors. In Malaysia, Ariffin and Zakili found that residents tend to hold high awareness (more than 80%) of environmental risk as well as prevalent persistence (more than 60%) in environmentally malign action [15]. The ubiquity of such results is underpinned by this survey, and the link between environmental awareness and proper behavior that Tong, Peake and Braund proposed is questioned again [16]. As Table 2 reveals, those who throw medicines in mix with household garbage are actually quite aware what their actions mean environmentally. None of them considers this way scientific, and over half of the convenience- and habit-driven subgroups admit that their behavior will do harm to the nature. Their awareness sheds light on voluntary behavioral change upon the condition that recycling becomes as easy as throwing carelessly. This vision actually was evidenced in this survey. Although only a few numbers of people knew the location of recycling facilities, they were definitely choosing to recycle the medicine as specific kind of garbage. For those who had no access to such facilities, throwing unused/expired medicine with household garbage was predominant.

Table 2 Main ways to dispose, reason and perception of environmental effect

	Convenience	Science	Habit	Other's advice	Total
Throw with other waste	97	0	48	1	146
No effect	37	0	15	1	53
Big negative	16	0	6	0	22
Small negative	40	0	23	0	63
Big positive	0	0	1	0	1
Small positive	4	0	3	0	7
Recycle as particular waste	2	23	14	5	44
No effect	1	7	4	0	12
Big negative	0	1	1	0	2
Small negative	1	3	6	1	11
Big positive	0	8	1	2	11

Small positive	0	4	2	2	8
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Another one third in the two subgroups, however, are far less sensitive with the environmental hazard caused by medicines, claiming that there will be no effect. More mass awareness-raising campaigns are needed to fill such a big knowledge gap. The necessity of better publicity is further underlined by the ratios of reasons and perceptions within the doing-the-right group, namely recycling as particular waste. Even the science-driven subgroup, the great majority of which have seen or heard publicity of medicines recycling (Table 3), has no prevailing idea how the perceived scientific way will affect environment. The embarrassing lack of common sense within the doing-the-right group points to that not only should the importance of scientific disposal be highlighted, but also more scientific details on the environmental impact of medicines should be elaborated.

Table 3 Main ways to dispose, reason and whether to see or hear about drug recycling

	Ever saw or heard	Never saw or heard	Total
Throw with other waste	33	113	146
Convenience	23	74	97
Science	0	0	0
Habit	9	39	48
Other's advice	1	0	1
Recycle as particular waste	33	11	44
Convenience	1	1	2
Science	18	5	23
Habit	10	4	14
Other's advice	4	1	5

The need of elaborating scientific details publicly is surprisingly echoed by the fact that the group of the highest educational qualification (postgraduate) reports the lowest proportion of scientifically thinking how to dispose medicines, as Figure 4 demonstrates. Its proportion of recycling medicines as particular waste is also lower than any other qualification groups'. The assumed positive relevance between education and environment-friendly mindset is further challenged. For developing countries, the lessons from developed ones are indicative of the top priority of governments or enterprises offering permanent accessible facilities for unwanted medicine disposal. Only upon this infrastructural premise can education and publicity change public practice effectively.

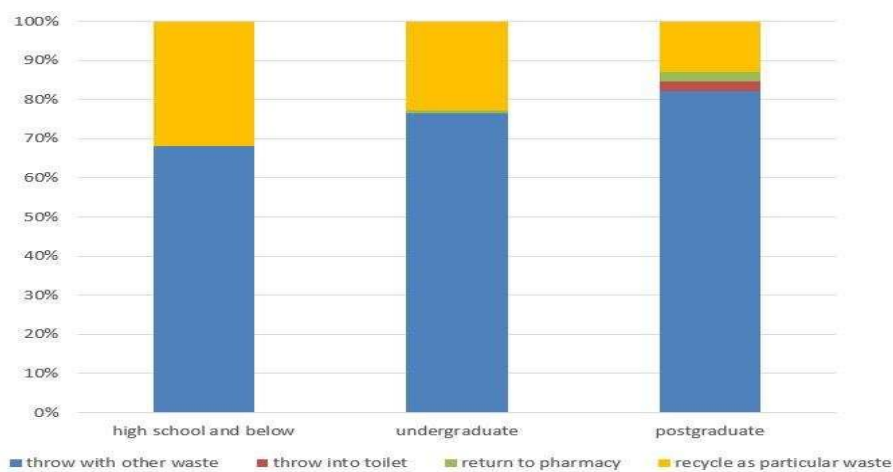


Figure 4 Education and way of disposal

There are some meaningful findings related to age. The scale of home medicine storage reported by people below 20 years old resembles that by the group aged 40 to 59. The two groups typically constitute families of middle-aged parents and teenage dependents, and thus it is understandable that children either knew what their parents knew or paid no attention to the inventory in their houses. However, Figure 5 reveals a big generational gap with respect to active engagement in medicine recycling. Young people's low willingness is an alarming sign of the city's insufficient education and publicity regarding this issue, while the senior generation's high interest in recycling is indicated in this online survey and should be examined further, especially in a way that can cover a bigger sample than web-based channels. This result calls for more effective policy which can reach and mobilize the elderly as major medical service users to engage in more environment-friendly dispose of drugs.

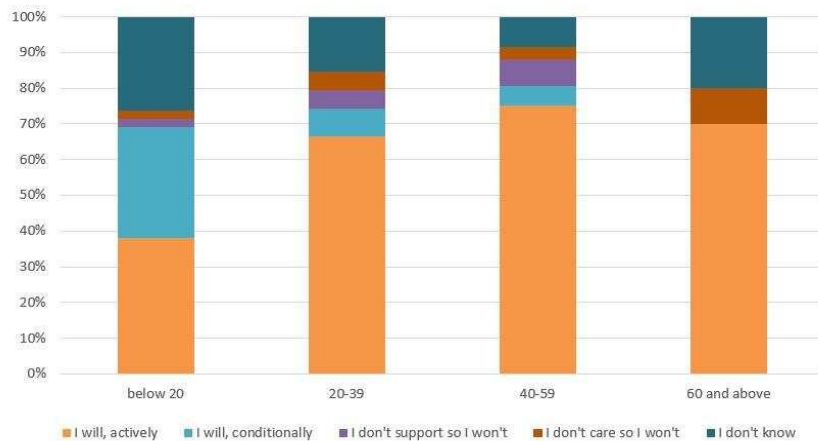


Figure 5 Age and willingness to recycling medicine

The perceived environmental progressiveness among young people is also undermined by an interesting negative relevance between age and attitude towards capping how much medicines one can buy (Figure 6). The youngest group submitted the least support while people over middle age predominantly welcomed the proposal. This finding underpins the necessity of setting up more effective publicity on young people over rational purchase of pills, especially the over-the-counter ones that they can get easily without prescription. Nevertheless, this trend can lend reference to medical service institutions imposing more regulation on the usage and consumption of medicines, as the groups in middle age and above are generally in favor of stricter medicine management. It is of great meaning as the overwhelming scale and speed of aging in China has been placing massive pressure on the country's medical service.

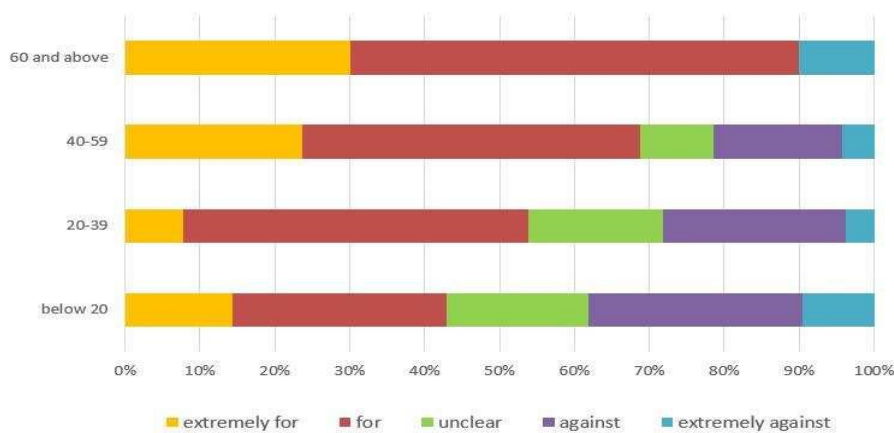


Figure 6 Age groups' approval of purchase-capping policy

There is no difference between sexes in the behaviors related to drug waste disposal. Interestingly, however, women are more willing than men to actively participate into drug recycling activities as Figure 7 shows. There are several reasons which are responsible for this result's occurrence. It is mostly females who are in charge of the family. To be specific, females tend to focus and know more about household affairs than males. This pattern might lead to the result that females are more familiar with the medicine how many pills are stocked in the house. They may concern more about activities that relate to the expired medicines, which might cause effects large and small health impacts on the family.

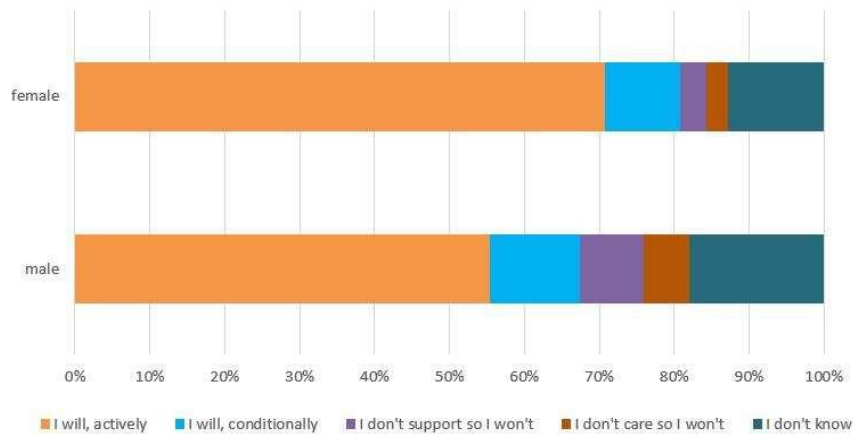


Figure 7 Sex and willingness to take part in medicine recycling campaign

Most Beijing residents believe the government and the pharmacy enterprise are the first and second to be accountable of medicine waste recycling, but far fewer consider the hospital and pharmacy. Each educational qualification level saw nearly half of its population share the viewpoint that government should take the first responsibility for medicines recycling, but their opinions on the ranking of other stakeholders vary (Figure 8). College graduates are inclined to attribute more duty onto pharmaceutical industries than recycling business, just in contrast with the attitude of people without college degree. It is interesting to see what roles hospitals are expected to play with respect to drug use management from the perspectives of different social groups. In addition, more people who have the educational background below the undergraduate select "strongly agree" with the policy with benefits, and less of them choose "agree", while the people who have the postgraduate educational background present the opposite result. This may lead to the explanation that the benefits are more attractive to people who have lower degree, and the postgraduate hold a more conservative thinking about the policy.

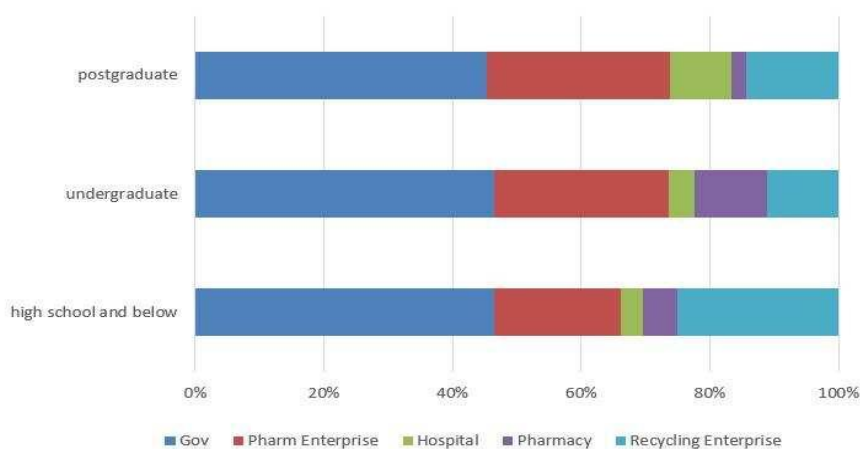


Figure 8 Education and perception of the first responsibility of recycling medicines

The limitations of this survey lie in questionnaire design and sampling. When using the notion of pharmaceutical or medicine waste, this survey did not classify drugs into any subcategory of physical state, price, provider, etc., for people tend

to throw unwanted medicines away without considering different solutions for different types. However, these factors may make difference in people's mind. In terms of physical state, oral liquids are more likely to be poured into sinks than mixed with solid wastes. Within out-of-date medicines, the expensive ones are more likely than the cheap to be retained, especially for economically struggling families. The insufficient size of elders in the sample rendered an important stakeholder group in the issue of medical service partly absent from the research. In the design of future research, the access to elders must be taken into account.

Conclusion

This paper focused on Beijing residents' knowledge, practice and attitude regarding how to dispose of unused and expired medicines. Questionnaire results show that the majority knew a little about the potential risk of drug waste on environment but did not understand much; that they got used to throwing drug wastes with other household garbage conveniently, under the circumstance that few recycling infrastructures were set adjacent to their home; that they would like take part in scientific disposal campaign, hold governments and pharmacies accountable, and prefer rewarding over restrictive policies. The results draw reflection to the key factors that determine the success of drug recycling initiatives. Priority should be put on infrastructural building so that people can turn what they know from education and media into scientific action quickly. Also, we need to expand the scope of this issue and raise public concerns to change public behaviors.

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