

September 9, 2025



Tiffany Skogstrom  
Executive Director, TURA Administrative Council  
The Commonwealth of Massachusetts  
Executive Office of Energy and Environmental Affairs  
100 Cambridge Street, Suite 1020  
Boston, MA 02114  
*Via Electronic Mail*

**Subject: HCPA Comments on the Proposal to Add Didecyl Dimethyl Ammonium Chloride (DDAC) and Alkyl Dimethyl Benzyl Ammonium Chloride (ADBAC) Subgroups of Quaternary Ammonium Compounds to 301 CMR 41.00 Toxic or Hazardous Substance List**

The Household & Commercial Products Association<sup>1</sup> (HCPA) thanks the Executive Office of Energy and Environmental Affairs for the opportunity to comment on the proposed amendments to 301 CMR 41.00 *Toxic or Hazardous Substance List* (TURA List), to add Didecyl Dimethyl Ammonium Chloride (DDAC) and Alkyl Dimethyl Benzyl Ammonium Chloride (ADBAC) subgroups of Quaternary Ammonium Compounds (quats).

HCPA is a premier trade association representing manufacturers and suppliers of a wide variety of products, such as household cleaning products and consumer pesticides, including disinfectants and sanitizers, that utilize quats as active ingredients. The products represented by HCPA are vital tools for maintaining clean and healthy homes and institutional facilities.

Under the Toxics Use Reduction Act (TURA) Program, adding DDAC and ADBAC subgroups to the TURA List would require Massachusetts-based producers to report on their chemical use, conduct toxics use reduction planning, and pay fees to support the program's implementation. *HCPA opposes this proposed addition due to concerns that this action will have an indiscriminate effect on the use of quats, including appropriate and beneficial applications for consumers and in workplace settings.*

**Existing Rigorous Federal and State Oversight**

Quats, which are widely used in disinfectants, are already rigorously evaluated and strictly regulated by the U.S. Environmental Protection Agency (EPA) under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). This comprehensive federal regulatory framework ensures that antimicrobial products, including those containing quats, meet stringent safety and efficacy standards before reaching consumers and commercial users. EPA only registers disinfectant products under FIFRA and approves them for use after conducting an extensive review of data on their potential impacts to human health and the environment.

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<sup>1</sup> The Household & Commercial Products Association (HCPA) is the premier trade association representing companies that manufacture and sell \$180 billion annually of trusted and familiar products used for cleaning, protecting, maintaining, and disinfecting homes and commercial environments. HCPA member companies employ 200,000 people in the U.S. whose work helps consumers and workers to create cleaner, healthier and more productive lives.

As part of this process, EPA evaluates product efficacy before any antimicrobial claims against viruses, bacteria, or other pathogens appear on a product label. Importantly, this is not a one-time review. FIFRA requires ongoing oversight through registration review of registered pesticide every 15 years to ensure that each pesticide can carry out its intended function(s) without creating unreasonable adverse effects to human health and the environment. Quats are currently undergoing such a review, which is intended to identify and address evolving science including any concerns with this class of chemicals to ensure continued safe and effective uses.<sup>2</sup> This ongoing review process demonstrates EPA's commitment to maintaining current safety standards while allowing beneficial uses of these important antimicrobial agents.

Additionally, all pesticides, including disinfectants containing quats, must be registered with the Massachusetts Department of Agricultural Resources to be distributed, purchased, or used in Massachusetts.<sup>3</sup> These comprehensive regulatory structures provide multiple layers of protection and ensure that quat-containing products continue to meet appropriate safety and efficacy standards throughout their commercial lifecycle.

### **Addressing Concerns on Misuse/Overuse of Quats**

The recommendation for the proposed addition of these substances to the TURA List is based on human health and environmental concerns outlined in a policy analysis conducted by the Toxics Use Reduction Institute (TURI) at the University of Massachusetts Lowell.<sup>4</sup> In reviewing the science on DDAC and ADBAC, the TURA Science Advisory Board (SAB) identified concerns including respiratory irritation and inflammation, corrosive effects, aquatic toxicity, and environmental persistence, as well as potential reproductive and developmental effects.

We acknowledge the concerns about misuse and/or overuse of certain quats, particularly in response to extraordinary event such as a pandemic, which formed the basis for much of the policy analysis data. However, we should not discount the overall societal benefits of these chemicals when used appropriately and according to label instructions. When used as directed, disinfectants, including those formulated with quats, are safe, effective, and meet the rigorous standards established by EPA under FIFRA. In fact, these products play a critical role in addressing public health needs, not only in homes but also in critical environments, such as healthcare facilities, schools, and workplaces.

Safety remains the top priority of the household and commercial products industry, and consumers can be confident that disinfecting products are safe when used responsibly and according to the directions on the label.

The TURA Program is designed to track and reduce the use of toxic substances in manufacturing processes, but the concerns identified by TURI relate primarily to:

- End-use applications rather than manufacturing processes;
- User behavior and training deficits rather than inherent toxicity when properly used; and
- Situational misuse during extraordinary circumstances such as the COVID-19 pandemic.

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<sup>2</sup> <https://www.epa.gov/pesticide-reevaluation/upcoming-registration-review-actions>

<sup>3</sup> <https://www.mass.gov/pesticide-product-registration>

<sup>4</sup> <https://www.mass.gov/doc/quaternary-ammonium-compounds-draft-policy-analysis-june-2023/download>

We are concerned that listing under TURA will not address the root cause of improper use that is discussed in TURI's policy analysis. Instead, the TURA reporting and planning requirements impose administrative and financial burdens on manufacturers without providing mechanisms to address the actual workplace safety and training issues that drive misuse/overuse. Adding these substances to the TURA list could inadvertently:

- Discourage beneficial uses where proper application is essential for public health;
- Create supply chain disruptions for critical disinfection needs; and
- Divert resources from targeted educational and training initiatives.

We believe that the issues identified by the SAB would be more effectively addressed by occupational health authorities in Massachusetts rather than through the TURA Program. Occupational health authorities have well-established infrastructure to address educational gaps regarding proper use, track and respond to misuse and/or overuse situations and provide targeted interventions where needed. Such an approach would more directly address the concerns raised while avoiding unnecessary regulatory burdens on producers of these critical substances, who play an essential role in supplying quats for disinfectant products that serve as important public health tools across many settings.

### **Inadequate Alternatives Analysis**

The TURI policy analysis also contains significant shortcomings that undermine the basis for this proposed listing. The report does not examine whether the suggested alternatives are available for any uses other than disinfection applications, nor does it systematically evaluate whether these chemistries can serve as safe and efficacious replacements for quats across their full scope of EPA-approved uses.

The alternatives identified in the TURI policy analysis are not suitable replacements for the listed quats. The analysis overlooks the fact that proposed substitutes often cannot match the broad-spectrum antimicrobial efficacy of quats against viruses, bacteria, fungi, and other pathogens. Quats achieve disinfection at low active ingredient concentrations, making them both resource-efficient and cost-effective. In contrast, many alternatives require higher concentrations, lack the versatility of quats across diverse applications, or present safety profiles that limit their use in sensitive settings.

We have significant concerns that the SAB analysis relies upon sweeping assumptions about human health and environmental risks without establishing a sound scientific basis for determining that suitable alternatives exist. Furthermore, this approach fails to differentiate between appropriate use scenarios where quats pose minimal risk and inappropriate use situations that could be addressed through training and proper application protocols, lacks comprehensive alternatives evaluation to verify that proposed alternatives can maintain the same level of public health protection, and overlooks the established public health benefits of proper quat use against theoretical risks from misuse.

The scientific integrity of regulatory decision-making requires a thorough, use-specific alternatives assessment before imposing burdens on producers who supply essential public health tools.

### **Conclusion**

*HCPA respectfully requests that the Executive Office of Energy and Environmental Affairs reconsider this proposal and refrain from proceeding with the listing.* The existing federal regulatory framework under FIFRA already provides comprehensive oversight of these chemistries, and targeted educational efforts

through occupational health authorities would more effectively address the specific concerns identified by SAB without creating unintended consequences for essential public health applications. The proposed TURA listing is based on incomplete scientific analysis that fails to demonstrate the availability of suitable alternatives for critical applications.

HCPA also supports the comments submitted by the Center for Biocide Chemistries and encourages consideration of their comments and concerns.

We appreciate your consideration of these comments and remain available to provide additional information or clarification as needed.

Sincerely,

A handwritten signature in black ink, appearing to read 'Lígia Duarte Iler', enclosed within a large, loopy oval shape.

Lígia Duarte Iler  
Senior Director, Regulatory Affairs  
Household & Commercial Products Association

September 12, 2025

Tiffany Skogstrom  
Executive Director of the TURA Administrative Council  
Executive Office of Energy and Environmental Affairs  
100 Cambridge Street, Suite 1020  
Boston, MA 02114  
Transmitted via [tiffany.skoqstrom@mass.gov](mailto:tiffany.skoqstrom@mass.gov)

Subject: Proposed Amendments to 301 CMR 41: Toxic or Hazardous Substance List (TURA List): Quaternary Ammonium Compounds

Dear Executive Director Skogstrom,

The ADBAC Issues Steering Committee (ADBAC ISC) and DDAC Issues Steering Committee (DDAC ISC)<sup>1</sup> appreciates the opportunity to provide comments on the proposed revisions to 301 CMR 41 *Toxic or Hazardous Substance List* (TURA List) to add a substance category of Didecyl Dimethyl Ammonium Chloride (DDAC) and Alkyl Dimethyl Benzyl Ammonium Chloride (ADBAC) subgroups of Quaternary Ammonium Compounds. We respectfully oppose this proposal.

Quaternary ammonium compounds (QACs) have been widely used in a variety of household, institutional, and industrial products for decades. QACs consist of several sub-classes, including but not limited to ADBAC and DDAC subgroups which are registered active ingredients for use in antimicrobial products that are highly regulated by the US Environmental Protection Agency (EPA), Massachusetts Department of Agricultural Resources among other state agencies, and other regulatory agencies around the world. The ADBAC and DDAC subgroups are critically important public health tools used to prevent or control the spread of pathogens associated with many serious public health diseases in environments where we live, work, learn, and play. Questioning the use of QACs may inadvertently promote the use of cleaning products or home remedies that clean but fail to disinfect. Studies have shown that cleaning without properly disinfecting spreads viruses to more surfaces, which increases the risk of infection.

The ADBAC and DDAC subgroups have been studied extensively for safety and toxicity, environmental effects, and efficacy/performance. There is a large and robust mammalian and environmental toxicology dataset that has been generated<sup>2</sup> for the ADBAC and DDAC

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<sup>1</sup> The ADBAC and DDAC ISCs are science-based task forces formed to conduct studies and analysis necessary by the U.S. Environmental Protection Agency (EPA) for federal registration and related risk assessment activities for alkyl dimethyl benzyl ammonium chloride (ADBAC) and didecyl dimethyl ammonium chloride (DDAC) based disinfectants. The ADBAC and DDAC ISCs are administered by Ignite Solutions, the consortium management program of the Household & Commercial Products Association.

<sup>2</sup> The ADBAC and DDAC database includes but is not limited to:

- 10 developmental / reproductive guideline studies showing no evidence of maternal or development toxicity.
- Several oral repeat dose guidelines studies showing no systemic toxicity.
- Inhalation repeat dose toxicology studies demonstrated effects consistent with the QAC mode of action – direct acting irritation.

subgroups which substantiate their safe use. The dataset that supports their registration around the world has been conducted following GLP procedures and conducted according to well-established US EPA, EU, or OECD test guidelines. Thorough peer review occurs directly by regulatory agency staff worldwide, ensuring that these studies follow proper methodology and are of high quality.

It is common practice among the regulatory agencies responsible for regulating antimicrobial products to conduct health protective risk assessments for each active ingredient for all labeled uses and application types. These conservative assessments are conducted for occupational and residential uses employ the highest permitted use rate for a particular application and require an appropriate margin of safety for each application. It should be noted that the US EPA includes cumulative risk as part of the risk assessment process. ADBAC and DDAC subgroup safety data are also supported by human subjects' exposure studies of task-specific application of antimicrobials. In the worker studies, subjects' exposures to the active ingredient are monitored with multiple dosimeters while conducting specific applications of antimicrobial solutions and are subject to US EPA Human Subjects Review Board oversight. For each product use type, Unit Exposures (metrics that relay application amount to dermal, oral or inhalation exposure intake) are developed (e.g., see the current<sup>3</sup> US EPA 2021 surrogate table of Unit Exposures). Detailed summaries are publicly available in US EPA and EU registration documents.<sup>4,5,6,7</sup> A manuscript<sup>8</sup> has been recently published which further substantiates conclusions about the safety of these compounds made by domestic and international regulatory agencies.

ADBAC and DDAC QACs are direct acting irritants and disrupt membranes of point-of-contact cells only,<sup>9</sup> e.g., which includes outer membranes and mitochondria of surface cells.<sup>10</sup> The mode of action information database is very strong with *in vitro* studies providing evidence on the molecular initiating events (membrane disruption), while many *in vivo* animal studies are

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- Genotoxicity and cancer studies, which are negatives for these effects.
  - Acute ecotoxicity and environmental fate data that support the conclusion that ADBAC and DDAC QACs are not likely to concentrate in the aquatic environment.

<sup>3</sup> <https://www.epa.gov/sites/default/files/2021-05/documents/occupational-pesticide-handler-unit-exposure-surrogate-reference-table-may-2021.pdf>

<sup>4</sup> USEPA. 2017a. "Alkyl Dimethyl Benzyl Ammonium Chloride (ADBAC) Final Work Plan. Registration Review: Initial Docket Case Number 0350. EPA-HQ-OPP-2015-0737." <https://www.regulations.gov/document/EPA-HQ-OPP-2015-0737-0004>.

<sup>5</sup> USEPA. 2017b. "Didecyl Dimethyl Ammonium Chloride (DDAC) Final Work Plan. Registration Review: Initial Docket Case Number 3003. EPA-HQ-OPP-2015-0740." <https://www.regulations.gov/document/EPA-HQ-OPP-2015-0740-0004>.

<sup>6</sup> ECHA. 2015a. "Assessment Report Alkyl (C12-16) Dimethylbenzyl Ammonium Chloride Product-Type 8 (Wood Preservative)." <https://echa.europa.eu/documents/10162/b9030b10-c8af-211b-456a-4f4b11d509b7>.

<sup>7</sup> ECHA. 2015b. "Assessment Report Didecyl dimethylammonium Chloride Product-Type 8 (Wood Preservative)." [http://dissemination.echa.europa.eu/Biocides/ActiveSubstances/0067-08/0067-08\\_Assessment\\_Report.pdf](http://dissemination.echa.europa.eu/Biocides/ActiveSubstances/0067-08/0067-08_Assessment_Report.pdf).

<sup>8</sup> T.G. Osimitz & W. Droege (26 May 2025): Perspectives on safety of quaternary ammonium compounds (QACs), Journal of Toxicology and Environmental Health, Part B, DOI: 10.1080/10937404.2025.2503784

<sup>9</sup> Wessels S, Ingmer H. Modes of action of three disinfectant active substances: a review. Regul Toxicol Pharmacol. 2013 Dec;67(3):456-67. doi: 10.1016/j.yrtph.2013.09.006. Epub 2013 Sep 27. PMID: 24080225.

<sup>10</sup> Inácio ÂS, et al. Mitochondrial dysfunction is the focus of quaternary ammonium surfactant toxicity to mammalian epithelial cells. Antimicrob Agents Chemother. 2013 Jun;57(6):2631-9. doi: 10.1128/AAC.02437-12. Epub 2013 Mar 25. PMID: 23529737; PMCID: PMC3716177.

available to characterize the key events (irritation and inflammation) toward adverse outcomes at higher doses. Importantly, human *in vitro* and *in vivo* data are also available. EPA's review of available data found that there is no evidence of cellular changes in tissues distant from the point of contact. These include high dose, short term studies as well as subacute, subchronic, and long-term toxicity studies in mice, rats, rabbits, or dogs, and from all routes of exposure (inhalation, oral, and dermal). Secondary effects, such as changes in body weight were noted at high doses but are downstream and consistent with gut irritation, inflammation, and reduced food consumption. The lack of distant findings at distant tissues is consistent with the Absorption, Distribution, Metabolism, Excretion data, where ADBAC and DDAC have low oral absorption and very low dermal absorption, and are efficiently eliminated. Following dermal treatment, the primary route of exposure, no systematic toxicity was observed at any dose in long-term studies and the only effect reported was skin irritation. Notably, no *in situ* or systematic metabolism is relevant to ADBAC and DDAC toxicity.

All GLP studies of ADBAC and DDAC following the well-established Development and Reproductive (DART) guidelines<sup>11</sup> are negative for reproductive or developmental toxicity. There have been non-guideline studies<sup>12,13</sup> researching reproductive or developmental toxicity in mice treated with a corrosive concentration of mixed ADBAC and DDAC QACs in gel food, though these methodologies and conduct have been criticized for inappropriate dosage, animal husbandry stresses, inadequate characterization of maternal toxicity, and poor exposure control. The results of these non-guideline studies have not been utilized in EPA risk assessments, and the European Chemicals Agency noted the most recent publication in open literature searches but did not utilize as a result of not meeting the most minimal criteria for quality and reporting of essential data on the test substance or study conduct.

There is no evidence of ADBAC or DDAC causing endocrine effects. *In vivo* work has hypothesized the potential for altered steroidogenesis by QACs due to their mitochondrial toxicity potential, and some have intimated that this could be a mechanism for endocrine disruption.<sup>14</sup> However, the strong and extensive *in vivo* evidence does not support this hypothesis. In dozens of studies in mice, rats, rabbits, and dogs, there has been no evidence of changes to endocrine-responsive tissues following short-term or long-term dosing of ADBAC and DDAC, by oral, dermal, or inhalation routes. As previously discussed, ADBAC and DDAC are point-of-contact cytotoxic agents that act by membrane disruption and mitochondrial toxicity to surface cells only (no cell necrosis, hyperplasia, or other cell-based change has been observed other than at the point of contact). Further, there are no reproductive effects seen in properly conducted guideline studies.

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<sup>11</sup> OPPTS 870.3700/3800; OECD 414/416

<sup>12</sup> Melin VE, et al. Quaternary ammonium disinfectants cause subfertility in mice by targeting both male and female reproductive processes. *Reprod Toxicol*. 2016 Jan;59:159-66. doi: 10.1016/j.reprotox.2015.10.006. Epub 2015 Nov 12. PMID: 26582257.

<sup>13</sup> Hrubec TC, et al. Ambient and Dosed Exposure to Quaternary Ammonium Disinfectants Causes Neural Tube Defects in Rodents. *Birth Defects Res*. 2017 Aug 15;109(14):1166-1178. doi: 10.1002/bdr2.1064. Epub 2017 Jun 15. PMID: 28618200; PMCID: PMC5905424.

<sup>14</sup> Datta, S., et al. (2017). In vitro evaluation of mitochondrial function and estrogen signaling in cell lines exposed to the antiseptic cetylpyridinium chloride. *Environmental health perspectives*, 125(8), 087015.

There are also full datasets of environmental fate and ecological toxicity studies for ADBC and DDAC. ADBAC and DDAC are readily biodegradable, as seen in studies conducted following OECD 307 and OECD 308 guidelines. ADBAC and DDAC are strongly adsorptive and rapidly partition to soil/sediment, making them essentially immovable and unlikely to leach or accumulate in surface or ground water.<sup>15</sup> Not only are ADBACs and DDACs QACs unlikely to bioconcentrate in the aquatic environment,<sup>16</sup> but ADBAC and DDAC are removed during wastewater treatment by biodegradation and sorption.<sup>17</sup>

Thank you for your consideration of these comments. Given the extraordinarily long history of the safe use of ADBAC and DDAC subgroups and the ongoing registration of these substances in not just the United States, but by all global regulatory agencies, these chemicals are a poor candidate for the TURA Listing. QACs control and prevent the spread of serious illnesses in hospitals, homes, schools, and food processing and preparation establishments. Please contact me at [ngeorges@thehcupa.org](mailto:ngeorges@thehcupa.org) if you would like to discuss this request.

Respectfully submitted,



Nicholas B. Georges

Executive Director

Ignite Solutions

On Behalf of the ADBAC Issues Steering Committee (ADBAC ISC)

And DDAC Issues Steering Committee (DDAC ISC)

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<sup>15</sup> Adsorption to suspended matter, solids, and soils significantly reduces toxicity

<sup>16</sup> Pati, S. G., & Arnold, W. A. (2020). Comprehensive screening of quaternary ammonium surfactants and ionic liquids in wastewater effluents and lake sediments. *Environmental Science: Processes & Impacts*, 22(2), 430-441.

<sup>17</sup> DeLeo, P.C. et al. Assessment of ecological hazards and environmental fate of disinfectant quaternary ammonium compounds, *Ecotoxicology and Environmental Safety*, Volume 206, 2020, 111116, ISSN 0147-6513, <https://doi.org/10.1016/j.ecoenv.2020.111116>.



September 12, 2025

Tiffany Skogstrom  
Executive Director of the TURA Administrative Council  
Executive Office of Energy and Environmental Affairs  
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Boston, MA 02114  
Transmitted via [tiffany.skogstrom@mass.gov](mailto:tiffany.skogstrom@mass.gov)

Subject: Proposed Amendments to 301 CMR 41: Toxic or Hazardous Substance List (TURA List): Quaternary Ammonium Compounds

Dear Executive Director Skogstrom,

The Quat Science Group (QSG)<sup>1</sup> appreciates the opportunity to provide comments on the proposed revisions to 301 CMR 41 *Toxic or Hazardous Substance List* (TURA List) to add a substance category of Didecyl Dimethyl Ammonium Chloride (DDAC) and Alkyl Dimethyl Benzyl Ammonium Chloride (ADBAC) subgroups of Quaternary Ammonium Compounds. We respectfully oppose this proposal.

ADBAC and DDAC are a class of quaternary ammonium compounds (QACs) that are a demonstrably safe, necessary, and effective tool for combating bacteria and viruses. Quat-based products are approved for use in all settings, including homes, healthcare, restaurants, retail, and food processing facilities, and are recognized by the U.S. Environmental Protection Agency (EPA) and other agencies around the world for their effectiveness.

The Toxic Use Reduction Institute (TURI) first proposed listing ADBAC and DDAC in 2020 when the use of QAC-containing products increased due to their effectiveness in preventing the spread of the COVID-19 virus. Indeed, QACs were one of the first product platforms added to the U.S. EPA “N” list of registered disinfectant products for this purpose and constituted about two-thirds of the products listed.

There are various considerations that must be made when formulating and selecting an antimicrobial product for different applications. ADBAC and DDAC QACs have unique attributes that make them very favorable as an active ingredient for use in antimicrobial products. Not all antimicrobial active ingredients are fit for each purpose or use. In selecting the appropriate active ingredient, the formulation, targeted pathogens, and projected use profile must all be taken into consideration. QACs have many benefits over other registered active ingredients

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<sup>1</sup> The Quat Science Group (QSG), formerly known as the Quat Residue Group (QRG), is a science-based task force formed to conduct studies and analysis necessary by the U.S. Environmental Protection Agency (EPA) for federal registration and related risk assessment activities for alkyl dimethyl benzyl ammonium chloride (ADBAC) and didecyl dimethyl ammonium chloride (DDAC) based disinfectants. Its members include companies that make sanitizing and disinfecting products and companies that manufacture antimicrobial quaternary ammonium compounds. The QSG is administered by Ignite Solutions, the consortium management program of the Household & Commercial Products Association.

such as safety and handling, stability, formulation flexibility, high dilution potential, product performance or micro-efficacy cost, material compatibility, and cleaning ability. While QACs are irritants, it must be noted that all active ingredients present inherent hazards. The hazards of the alternatives identified in the TURA Policy Analysis Draft June 2023 document<sup>2</sup> include respiratory or dermal irritation or corrosion, flammability, and/or respiratory or dermal sensitization.

Importantly, disinfectants and sanitizers containing ADBAC and DDAC active ingredients are safe when used in accordance with label directions. ADBAC and DDAC have been extensively studied for over 30 years with regards to safety and toxicity, environmental effects, and efficacy/performance. There is a robust dataset from studies which have been conducted to internationally recognized quality standards and technical guidelines and which substantiate their safe use. While this research is not publicly available, it is reviewed by expert regulatory agency staff worldwide and would reject any study that isn't of high quality. These studies show that there are no evidence of developmental and reproductive effects in repeated doses, no evidence of endocrine effects, have low sensitization potential, are readily biodegradable, are strongly adsorptive and rapidly partition to soil/sediment (making them essentially immobile and unlikely to leach or accumulate in surface or ground water), and unlikely to bioconcentrate in the environment due to rapid degradation. The mode of action of these substances is point-of-contact irritation, disrupting the membranes of bacteria and the outer coatings of viruses. Because of the non-specific nature of the antimicrobial mechanism of action of disinfectant QACs, it is unlikely that viruses or bacteria can develop resistance to them.<sup>3</sup>

Detailed summaries are publicly available in US EPA and EU registration documents highlighting the safety of these products.<sup>4,5,6,7</sup> Additionally, the QSG recently sponsored a review<sup>8</sup> of all available information, which not only includes the guideline studies, but also non-guideline research conducted by other stakeholders. These results further substantiate the conclusions made by global regulatory agencies demonstrating the safety of ADBAC and DDAC.

After years of study and multiple reviews by various agencies such as the U.S. EPA and EU European Chemicals Agency (ECHA), proper use of QACs is well understood to maximize their

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<sup>2</sup> <https://www.mass.gov/doc/quaternary-ammonium-compounds-draft-policy-analysis-june-2023/download>

<sup>3</sup> Gerba CP. 2015. Quaternary Ammonium Biocides: Efficacy in Application. Appl Environ Microbiol 81:1. <https://doi.org/10.1128/AEM.02633-14>

<sup>4</sup> USEPA. 2017a. "Alkyl Dimethyl Benzyl Ammonium Chloride (ADBAC) Final Work Plan. Registration Review: Initial Docket Case Number 0350. EPA-HQ-OPP-2015-0737." <https://www.regulations.gov/document/EPA-HQ-OPP-2015-0737-0004>.

<sup>5</sup> USEPA. 2017b. "Didecyl Dimethyl Ammonium Chloride (DDAC) Final Work Plan. Registration Review: Initial Docket Case Number 3003. EPA-HQ-OPP-2015-0740." <https://www.regulations.gov/document/EPA-HQ-OPP-2015-0740-0004>.

<sup>6</sup> ECHA. 2015a. "Assessment Report Alkyl (C12-16) Dimethylbenzyl Ammonium Chloride Product-Type 8 (Wood Preservative)." <https://echa.europa.eu/documents/10162/b9030b10-c8af-211b-456a-4f4b11d509b7>.

<sup>7</sup> ECHA. 2015b. "Assessment Report Didecyl dimethylammonium Chloride Product-Type 8 (Wood Preservative)." [http://dissemination.echa.europa.eu/Biocides/ActiveSubstances/0067-08/0067-08\\_Assessment\\_Report.pdf](http://dissemination.echa.europa.eu/Biocides/ActiveSubstances/0067-08/0067-08_Assessment_Report.pdf).

<sup>8</sup> T.G. Osimitz & W. Droege (26 May 2025): Perspectives on safety of quaternary ammonium compounds (QACs), Journal of Toxicology and Environmental Health, Part B, DOI: 10.1080/10937404.2025.2503784

effectiveness against bacteria and viruses, and to protect the safety of consumers at home and workers in industrial, institutional, and commercial settings. The Quats Education Program provides instruction on Disinfectant QAC-based products and how the product must be applied in order to assure sanitizing and disinfecting efficacy. Following the label instructions is essential to assure efficacy and effective disinfecting of any product.

Given the extraordinarily long history of the safe use of the Disinfectants QACs, the ongoing registration of these chemicals in Europe by ECHA and registration review by the U.S. EPA, products containing Disinfectant QACs are a poor candidate for listing or monitoring by State Programs. Further, dissuading the use of Disinfectant QACs is unjustified; constitutes unwise public health policy; and risks undermining consumer and institutional confidence in an effective, safe, and important product that would help reduce transmission and infection rates.

The QSG thanks the Executive Office of Energy and Environmental Affairs for the consideration of these comments. Please do not hesitate to contact us for further information.

Respectfully submitted,

A handwritten signature in cursive script that reads "Nicholas Georges".

Nicholas B. Georges  
Executive Director  
Ignite Solutions  
On Behalf of the Quat Science Group



**September 12, 2025**

The Commonwealth of Massachusetts  
Executive Office of Energy and Environmental Affairs  
Attention: Tiffany Skogstrom, Executive Director of the TURA Administrative Council  
100 Cambridge Street, 10th Floor  
Boston, MA 02114

**Subject: Arxada Response to Amend TURA List to add Didecyl Dimethyl Ammonium Chloride (DDAC) and Alkyl Dimethyl Benzyl Ammonium Chloride (ADBAC) subgroups of Quaternary Ammonium Compounds**

Dear Mrs. Skogstrom,

Arxada LLC, appreciates the opportunity to submit comments to the State of Massachusetts regarding the proposed amendment to add substance category of Didecyl Dimethyl Ammonium Chloride (DDAC) and Alkyl Dimethyl Benzyl Ammonium Chloride (ADBAC) subgroups of Quaternary Ammonium Compounds to the TURA List.

We are a global leader providing trusted solutions to help protect public health -in both homes and in professional settings. Arxada is a leading manufacturer and developer of ADBAC and DDAC, which are key active ingredients used in the formulation of disinfectants and sanitizers for household, institutional, and commercial applications. These products are essential tools for maintaining hygiene in hospitals, healthcare facilities, food processing and service establishments, and residential environments. They play a critical role in disinfecting and sanitizing surfaces, helping prevent the spread of harmful microorganisms that can cause serious illness.

Quaternary Ammonium Compounds (QACs or Quats) products including ADBAC and DDAC chemistries, possess unique properties that are not easily replicated by other chemistries currently available. In some cases, no viable alternatives exist. For example, there are no approved food-contact sanitizers based solely on hydrogen peroxide for use in food processing or service environments. Quaternary ammonium compounds (QAC) like ADBAC and DDAC are highly versatile, easily concentrated for dilutable products, and effective across a wide range of applications

Their proven efficacy and adaptability have made quats the preferred active ingredients in both professional and consumer settings. A TURA listing that discourages their use could lead to serious unintended consequences, including reduced access to effective sanitation tools and increased public health risks.

In the following comments, Arxada focus on the safety profiles for two main antimicrobial sub-classes of quaternary ammonium compounds (QACs) - alkyl dimethyl benzyl ammonium

chloride (ADBAC)<sup>1</sup> (US EPA, 2017b) QACs and didecyl dimethyl ammonium chloride (DDAC)<sup>2</sup> (US EPA, 2017a) QACs. In these comments, we (1) provide details and factual statements regarding Quats and point to sources where the TURA Science Advisory Board (SAB) can seek additional toxicological data on these substances; (2) reference safety decisions made by other regulatory authorities; and (3) ask the State of Massachusetts to consider the body of data that exists for well understood quats including those evaluated for FDA and EPA regulated products. We believe that a careful and thorough evaluation of the full set of quality data on these substances will demonstrate that they should not be included on the TURA list.

### **Regulatory Framework**

QACs are considered workhorse disinfectants: they are fit-for-purpose, safe, and highly effective when used according to label directions. Their reliability and ease of use have made them a preferred choice across industries when used as directed. The various regulatory agencies around Globe have collectively reinforce the critical role of QACs in maintaining hygiene and preventing the spread of infectious diseases. Their proven efficacy at low concentrations further supports their widespread use in both concentrated and ready-to-use formulations.

ADBAC and DDAC have been extensively studied for safety and toxicity and environmental effects over several decades. There is a robust database of guideline studies that have been developed, stringently evaluated, and accepted by regulatory bodies across the world, and which substantiate the safe use of these antimicrobial QACs. Although much of the data is not currently published in the peer-reviewed literature, detailed summaries are publicly available in US EPA and EU registration documents. These high-quality studies conducted to internationally recognized guidelines and the principles of Good Laboratory Practice (GLP) have consistently shown no specific systemic toxicity, and no evidence of mutagenicity, sensitization, carcinogenicity, or developmental or reproductive effects. In addition, the data consistently demonstrate that these antimicrobial QACs are well removed during wastewater treatment, are not bio accumulative and are not persistent in the environment. We provide more specific comments on the human and environmental safety of these substances further down in this document.

### **Public Health Importance**

Antimicrobial quaternary ammonium compounds (QACs) are a vital tool in protecting public health. They play a critical role in preventing and controlling the spread of serious disease in environments where we live, work, learn, and play.

### **Unique Properties of Quats**

Quaternary ammonium compounds are known for their unique chemistry attributes and versatility. These cationic surfactants are highly concentrated and can be easily diluted into ready-to-use solutions, making them cost-effective and scalable for everything from hospital-grade disinfectants, food service industry, and household cleaners. Quats are

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<sup>1</sup> 19 individual CAS numbers, including benzalkonium chloride and benzethonium chloride.

<sup>2</sup> 5 individual CAS numbers EPA Registered Disinfectants And see: EPA Disinfectant List (PDF) <sup>3</sup>2017 US FDA Food Code,

uniquely versatile—they can be formulated as either concentrated or ready-to-use solutions, offering flexibility across sanitation protocols. Quats are also stable in hard water, non-corrosive, and low-odor, making them ideal for repeated use on sensitive surfaces. Unlike bleach or peroxy compounds, quats are non-corrosive and surface-safe, leaving no residue or damage on materials like stainless steel, plastic, or painted surfaces. Their low odor profile makes them ideal for enclosed environments, and they're approved by the EPA and FDA for sanitizing food-contact surfaces with established tolerances, ensuring safety in kitchens, food processing plants, and restaurants. With broad-spectrum antimicrobial efficacy and compatibility across industries, quats are the quiet workhorses behind modern hygiene and sanitation.

## **Efficacy Against Pathogens**

QACs/Quats are uniquely effective against a wide range of microorganism's bacteria and viruses that cause colds, influenza, and food-borne illnesses<sup>4</sup>. Their broad-spectrum antimicrobial activity makes them indispensable in both routine and high-risk sanitation settings. They are well known for their broad-spectrum antimicrobial activity, making them indispensable in the industry. Their molecular structure—featuring a positively charged nitrogen atom—allows them to disrupt the cell membranes of a wide range of microorganisms, including: Gram-positive bacteria (e.g., *Staphylococcus aureus*, *Bacillus subtilis*), Gram-negative bacteria (e.g., *Escherichia coli*, *Klebsiella pneumoniae*), Fungi and yeasts (e.g., *Candida albicans*, *Aspergillus niger*), Some enveloped viruses, due to their lipid membrane vulnerability.

## **Performance**

One of the key advantages of QACs is their efficacy at low concentrations. Most sanitizing and disinfecting formulations contain only a small percentage of QACs, yet deliver powerful antimicrobial performance—making them both cost-effective and practical for widespread use.

There are various considerations that must be made when formulating and selecting an antimicrobial product for different applications. ADBAC and/or DDAC QACs have unique attributes that make them very favorable as an active ingredient for use in antimicrobial products. In selecting the appropriate active, the formulation, targeted pathogens, and projected use profile must all be taken into consideration. QACs have many benefits over other registered active ingredients such as safety and handling, stability, formulation flexibility, high dilution potential, product performance or micro-efficacy, cost, material compatibility, and cleaning ability. Importantly ADBAC & DDAC are not volatile, are not dermally irritating at typical in-use concentrations, do not form hazardous degradation products, and have very low oral and dermal absorption.

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<sup>4</sup>[Selected EPA-Registered Disinfectants | US EPA](#) <sup>5</sup>[US FDA Food Safety Modernization Act \(FSMA\)](#) <sup>6</sup>[Role of FSMA and Importance of Sanitization in Food Processing Plants](#) <sup>7</sup>[US CDC Guidelines for Health Infection Prevention \(PDF\)](#)

The TURA SAB draft policy document summarizes some of the hazards listed in the peer-reviewed literature but does not transparently consider the quality or reliability of these data for decision making. The data does not compare in quality or breadth to the extensive regulatory data that has been generated over decades for compliance with global regulations. Furthermore, the SAB document has not conducted a risk assessment for the

QAC products or the alternatives, which makes it difficult to conclude whether the alternatives are truly a safer alternative for all the intended uses of QACs.

Arxada is committed to upholding high scientific standards in both the internal and external assessments of our products. In the following paragraphs, we provide additional information on the key concerns on the antimicrobial QACs (i.e., ADBAC and DDAC) raised in the Policy Analysis.

**Occupational and consumer exposure:** In North America and Europe, regulatory authorities are required to conduct risk assessments for all disinfectant ingredients to ensure that the levels of exposure are acceptable. Several manufacturers and registrants of antimicrobials have formed a task force to conduct state-of-the art exposure monitoring studies on antimicrobials, including QACs, during consumer and professional use scenarios (AEATF II, 2008). The study designs were agreed with the US EPA and the resulting data have been submitted, evaluated and incorporated into risk assessments for antimicrobial products.

#### **Dermal Effects:**

**Skin irritation/Rashes:** Quats are proven effective in very low concentrations, as described on labels, which makes them both safe and effective active ingredients. Although they are direct acting irritants at higher concentrations, when used as directed at low concentrations, quats have not been found to irritate skin. It is important that users always read and follow the label instructions before use of any cleaning products, including wearing gloves when recommended.

**Skin sensitization:** Antimicrobial QACs, including ADBAC, are not dermal sensitizers in numerous animal studies (ECHA 2021a,b,c, 2023). In addition, covalent binding to proteins to form a hapten, which is a molecular initiating event on the Adverse Outcome Pathway (AOP) for dermal sensitization (OECD, 2012), is unlikely to occur with QACs, considering their structure and how they interact with cellular structures (i.e., membrane disruption). Antimicrobial QACs have a long history of use as preservatives in cosmetics, eye drops, nasal sprays, and other medicines. Reported cases of sensitization in humans are rare, and as such, there is no broad concern over sensitization (e.g., Dao et al., 2012; Uter, et al. 2008).

**Asthma/Breathing problems/COPD:** The current weight of evidence does not support the fact that antimicrobial QACs cause new-onset asthma, due to their low volatility and lack of sensitization potential. While QACs are potential irritants, their low vapor pressure ( $\sim 10^{-10}$  mmHg) and larger particle sizes from aerosols that result from spraying mean they typically cannot maintain airborne concentrations, which greatly minimizes their abilities to be inhaled and induce respiratory irritation. Some case reports attributing asthma-like responses to quats in cleaning products exist, however it is generally difficult to make conclusions for products which could contain multiple components including fragrances and dyes. Furthermore, in most epidemiological studies that evaluate the cause of occupational and environmental induced asthma, determining quat-specific exposure as a cause of asthma is difficult due to many confounders present in the environment that are also linked to asthma, including bio allergens (pollen, dusts, dander) as well as other chemicals that



could trigger asthma. Although QACs, like other chemicals, may trigger asthma-like reactions through irritation in individuals who already have asthma, QACs are unlikely to be the source of occupational asthma for cleaning workers under regular occupational settings (Osimitz and Droege, 2021). Additionally, irritation responses and respiratory sensitization responses such as asthma can often be confused. As with any disinfectant or quat-based product, it is imperative for consumers to refer to the product's directions for use and manufacturer instructions for use to ensure proper usage.

### **Reproductive/Developmental Effects:**

Developmental and reproductive toxicity: There are 10 high quality GLP studies of antimicrobial quats that show that QACs are not reproductive and developmental toxicants (Bushy Run 1989, 1990, 1991a, 1991b, 1992a, 1992b; CIT 2005, 2008a, 2008b, 2008c), which have been summarized in publicly available reviews (Hostettler et al., 2021; Luz et al., 2020, US EPA 2006a, 2006b, 2006c, 2006d, 2017a, 2017b; DPR 1996; ECHA 2019, 2021a,b,c, 2023). This is the same conclusion reached by US EPA, California EPA and the European Union regulators (Cal/EPA -- DPR 1996; US EPA 2006a, 2006b, 2006c, 2006d, 2017a, 2017b; ECHA 2015). There are 3 additional published developmental or reproductive toxicity studies of quats that were negative for these effects, 2 in mice and 1 in rats (Fujitani et al. 2011; Palmer et al., 1983 and Momma et al., 1987). One set of researchers reported developmental or reproductive toxicity in mice treated with a corrosive concentrate mixed in food (Melin et al. 2014, 2016; Hrubec et al. 2017). However, these studies have been criticized for the use of inappropriately high doses and animal stress, failure to examine maternal toxicity, poor exposure control, as well as lacking many of the standard endpoints reported in developmental and reproductive toxicology studies (Hostettler, 2014, 2018; DeSesso et al., 2021). The evidence from multiple standard reproductive and developmental toxicity studies does not suggest that quat use in consumer products poses a risk of reproductive harm or birth defects. A recent systematic literature review of rodent data (DeSesso et al., 2021) used a weight of evidence approach that indicates no adverse developmental and reproductive effects upon exposures to QACs at anticipated concentrations in normal use.

Adsorption and metabolism: As permanently positively charged substances, antimicrobial QACs show very low potential to be taken up across barriers. Multiple oral ADME studies on both DDAC and C12-C16 ADBAC indicate that both are poorly absorbed via the oral route ( $\leq 10\%$ ), show very limited distribution, are primarily excreted in feces and show no potential to accumulate. Human in vitro dermal absorption studies on aqueous dilutions of antimicrobial QACs indicate very low levels ( $<0.1\%$ ) being absorbed through skin (Luz et al., 2020). These results are supported by a study in 32 subjects on systemic absorption of ADBAC after maximal use of a consumer antiseptic hand wash product. Following use of a soap containing 0.13% ADBAC 30 times per day for 5 consecutive days, plasma levels of the C12 homologue were below the lower limit of quantitation (LLOQ) by LC/MS-MS in all but 4 of the 1,024 samples collected, while the C14 homologue was below LLOQ in all but 1 sample (DeLeo et al., 2021).

Repeat dose studies and systemic toxicity: ADBAC and DDAC are direct acting irritants and, due to their surfactant properties, disrupt cellular membranes. The repeat dose toxicity



studies, which have been sponsored independently by different companies around the world and over decades, consistently demonstrate local effects occurring at first site of contact, with any other effects (e.g., body weight loss) being secondary effects due to inflammation or irritation at site of contact (ECHA 2019, 2021a,b,c, 2023, Osimitz and Droege, 2022; Luz, et al. 2020).

Residues on surfaces: Disinfectant directions for food contact surfaces often require a potable water rinse following application, which reduces the amount of residue that remains on a surface and therefore would reduce exposure. Residues on surfaces have not been associated with adverse effects, and any residues that could remain will degrade over time. Any residue left on surfaces or dust will be significantly lower than the concentration in the product, which is also evaluated for safety.

### **Environmental Fate**

TURA's Policy Analysis has suggested that QACs are persistent in the environment and have been found in surface waters, soil, sediments, and wastewater sludge. It has additionally raised concerns for microorganisms and aquatic organisms as well as the impact of QACs on wastewater treatment plants. Recent studies confirm that QACs are readily biodegradable, non-bioaccumulative, and effectively removed during wastewater treatment.

There is a growing body of evidence available demonstrating that QACs biodegrade well in both experimental and environmental conditions. Antimicrobial QACs have been shown to be readily biodegradable (DeLeo et al., 2020) in screening tests for ready biodegradability, which are considered stringent tests, providing an initial indication that these substances would be well removed during wastewater treatment. However, additional experimental (lab-scale) and monitoring data are available that support that these substances are highly removed during wastewater treatment (ECHA 2019, 2021a,b,c, 2023). These data are supported by the information in the peer reviewed literature, where sediment core samples indicated that QAC levels in sediment have been decreasing appreciably since the 1980s, being attributed to improvements in wastewater treatment processes (Pati and Arnold 2020).

Recently conducted aerobic soil biodegradation studies on <sup>14</sup>C-labelled ADBAC and DDAC, each conducted to GLP and globally accepted test guidelines in four soils of varying characteristics, showed degradation half lives ranging from 1.6 to 23.3 days (ECHA 2019, 2021a,b,c, 2023). Due to their strongly adsorptive properties and biodegradation, ADBAC and DDAC are essentially immobile and unlikely to leach or accumulate in surface or ground water (US EPA, 2017). Once in the aquatic environment, QACs tend to adhere to suspended matter and solids, which makes them less available to aquatic organisms and results in lower concentrations of dissolved QACs in the water. Experimental bioconcentration studies in fish have additionally demonstrated that ADBAC and DDAC show no potential to bioaccumulate (ECHA 2019, 2021a,b,c, 2023).

Overall, the evidence in both the peer reviewed literature as well in the regulatory dossiers submitted globally to support antimicrobial QACs are consistent to show QACs are well

removed during wastewater treatment, are not bio accumulative and are not persistent in the environment.

### **Overall conclusions**

Antimicrobial Quats/QACs (including ADBAC and DDAC) are used in products that are essential tools for institutional facilities, hospital, healthcare settings, food establishments, residential settings etc. to disinfect, sanitize and clean, thereby creating a more hygienic environment and preventing the spread of microorganisms which could cause harmful illnesses. Quats have properties that make them unique and not replaceable by other chemistries on the market at this time (easily concentrated etc.) which there are no equivalent replacements at this time. It takes many years to develop a product which can be easily diluted yet, is still safe and broadly effective. Listing these products under TURA may inadvertently restrict access to critical sanitation tools, posing risks to public health.

Arxada remains completely committed to the benefits of quat as many of the QACs identified in cleaning and beauty, hygiene, and personal care products have robust scientific data to support that products are safe and effective when used as directed. There is an extensive set of data to support quats/QAC including human and environmental toxicology, exposure data, and reproductive toxicity which has been reviewed and scientifically proven not to be harmful to humans or the environment. Arxada is committed to ensure continued commitment to the safe and responsible use of our products in protecting public health.

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September 8, 2025

Tiffany Skogstrom  
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RE: Comments of the Massachusetts Chemistry and Technology Alliance related to Proposed Amendments to 301 CMR 41: Toxic or Hazardous Substance List (TURA List)

Dear Ms. Skogstrom:

On behalf of our members, the Massachusetts Chemistry & Technology Alliance (MCTA) is pleased to comment on the July 3<sup>rd</sup> Proposed Amendments to 301 CMR 41: Toxic or Hazardous Substance List (TURA List). The proposed amendments, if adopted, will add a substance category of Didecyl Dimethyl Ammonium Chloride (DDAC) and Alkyl Dimethyl Benzyl Ammonium Chloride (ADBAC) subgroups of Quaternary Ammonium Compounds (QACs) to the TURA List.

MCTA is the professional organization representing manufacturers, users, and distributors of chemistry in the Commonwealth. Our membership ranges from small, multi-generational family-owned businesses operating with a handful of employees to large global companies employing thousands. More than 96% of all manufactured goods – from solar panels and turbine blades to automotive parts and pharmaceutical products – are touched by chemistry.

MCTA has been active on this issue for a long time, providing comments and discussion throughout the administrative process leading to the proposed amendments. The proposed amendments have a significant impact on our members and the tens of thousands of end-users of QAC containing products that rely on them to kill harmful bacteria and viruses for general disinfection or sanitation purposes.

MCTA has the following concerns with these proposed amendments:

**QACs are necessary for public health purposes and there are no effective substitutes**

According to TURI's own Policy Analysis (June 2023), QACs are widely used in consumer products and in commercial and institutional applications as antimicrobial inhibitors for cleaning

and disinfecting, primarily in medical or food preparation settings. The QACs listing in these proposed amendments cover almost all QACs in consumer and commercial and industrial uses.

That widespread and disparate use of QACs makes this rulemaking particularly ineffective.

Consumer products containing QACs are not subject to TURA, meaning no consumer exposure will be impacted by this rulemaking unless the product is made in Massachusetts in sufficient quantities to require TURA reporting. We are unaware of any product that meets those criteria.

QACs are also used in hospitals and medical facilities, potentially at reportable levels. However, neither industry is subject to TURA reporting. Likewise, restaurants or similar food service businesses are also not subject to TURA reporting. In these industries, where exposure could actually occur, there are no ramifications or safety impact from this regulatory action.

In fact, the June 2023 TURI Policy Analysis only identified one end-use industry as a user of QACs in sufficient quantities to require reporting under TURA. Those are large facilities involved in the food service industry. Initial reports indicate there may be two facilities that meet this TURA threshold for reporting.

This is a very odd industry to be targeting for action. In these facilities the use of FDA-approved QAC-containing materials is vital to disinfecting and cleaning food preparation and processing areas. Their use has without question resulted in a safer food supply, preventing food borne disease such as listeria and e-coli throughout the food chain. These materials are familiar to users and have been used without serious incidents for decades. They are used by trained personnel using appropriate safety protection when needed.

The substitutes identified by TURI are not as effective and do not result in the same level of safety for consumers. The substitutes also have other issues: some need much larger quantities to meet the same level of disinfection, increasing user costs, and many carry risks to human health.

### **Listing QACs will penalize in-state distributors of these materials**

As stated, the majority of uses of QACs that result in consumer exposure will not be impacted by this listing, either due to inapplicability of the TURA law or the use of very low quantities.

That means in addition to the two food suppliers mentioned, the burden of complying with this proposed ruling will be felt - once again - by Massachusetts - and only Massachusetts - distributors or repackagers of QACs, a handful of companies at most.

As a result, this proposed listing penalizes a group that is already struggling - in-state businesses trying to operate in Massachusetts. Since the majority of consumer uses will not be impacted by this listing, there is zero likelihood that any end-users will be looking for substitutes. This leaves the in-state distributors to just pay a fee, pass the costs to customers and perform a meaningless TURA plan to reduce the use of a product they have no control over and for which there is consumer demand. This bureaucratic exercise (and the costs associated with it) will be added to the already significant burdens these industries face in Massachusetts, including high taxes, high health care premiums and high energy costs.

And even with those few industries reporting, a sizable portion of QACs used here will not be regulated. Bulk quantities of QACs - regulated if they were distributed from Massachusetts



companies - are delivered from companies based in other states to local end-users. Once again, this adds to an unfair competitive arrangement where in-state companies that provide jobs and economic benefit here are disadvantaged while their out-of-state competitors serve the same clients without additional costs or regulatory burdens.

Regulating QACs in this manner is not only unfair but not impactful. If DEP or any agency is concerned about consumer exposure to QACs in restaurants, hospitals, or commercial establishments, it should defer to the Department of Public Health for outreach and education to those facilities.

**The Administrative Council vote to proceed to a regulatory action was not unanimous and was controversial**

On any action such as this, there should be clarity as to its regulatory goal and transparency in the regulatory process. That did not happen here.

Members of both the TURA Advisory Council and the Administrative Council questioned the listing of QACs under TURA. In fact, the final vote of the Administrative Council for the motion to open the public participation process for this listing was divided with three members voting in support, two opposed and one abstaining. No motion was made or seconded to approve the adoption of the chemistries under consideration - which is typically done before voting to authorize DEP to promulgate regulations and schedule a public hearing.

This unusual regulatory approach makes industry lose faith that their voices are being heard and considered during the proceedings.

**Summary**

QACs are vital to our public health and are widely used safely to prevent disease and food borne illnesses. During the recent Covid pandemic, their use increased as consumers, hospitals and even government agencies looked for ways to avoid a serious and deadly illness. *There is no doubt that the use and effectiveness of QACs saved lives.*

Consumer uses and behavior will not be impacted by this listing. QAC containing products will still be available on market shelves and on-line. Penalizing a few in-state companies is not the way to better public health.

We urge DEP to reject this proposed rule.

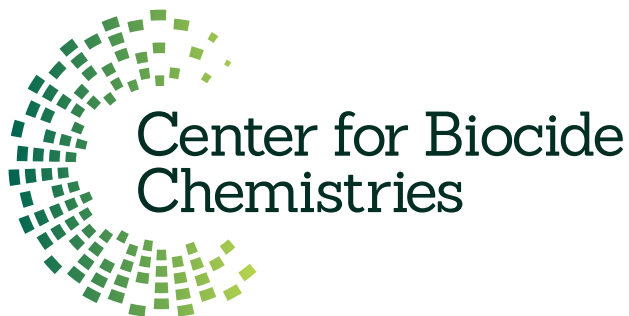
Thank you for your consideration. If you have any questions, please do not hesitate to contact me at 508-572-9113 or at [katherine@masscta.org](mailto:katherine@masscta.org).

Sincerely,



Katherine Robertson  
Executive Director

cc: Stephanie Cooper, Undersecretary for Environment



September 11, 2025

Tiffany Skogstrom  
TURA Administrative Council Executive Director  
[Tiffany.Skogstrom@mass.gov](mailto:Tiffany.Skogstrom@mass.gov)

**Submitted Electronically**

**RE: TURA Administrative Council's Decision to list Quaternary Ammonium Compounds**

The American Chemistry Council's Center for Biocide Chemistries<sup>1</sup> (CBC) appreciates the opportunity to provide comments on Toxics Use Reduction Action (TURA) Administrative Council's decision to add two subgroups of Quaternary Ammonium Compounds (QACs), Didecyl Dimethyl Ammonium Chloride (DDAC) and Alkyl Dimethyl Benzyl Ammonium Chloride (ADBAC), to the state's Toxic or Hazardous Substance List (TURA list). CBC strongly opposes this proposal and offers the following comments for consideration. CBC also supports the comments submitted by the Household & Commercial Products Association (HCPA).

**I. QACs are Heavily Reviewed and Regulated as Antimicrobial Pesticides**

QACs are used as antimicrobial disinfectants and preservatives in products regulated by EPA under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), and are subject to stringent risk assessment and risk management by US Environmental Protection Agency (EPA). Under FIFRA, QAC products must submit significant testing and data regarding the impact on human health and the environment of those products. QACs have been used as antimicrobials for over 80 years and have been extensively reviewed by EPA and regulatory authorities around the world.

QAC products that make public health claims, such as disinfectant and sanitizer products, must also submit data showing that the product is efficacious on any virus, bacteria, or other germs that the product label claims it kills. This data, along with the chemistry and toxicity data, is reviewed by EPA to help ensure that EPA-registered products are safe when used as directed on the label of the product.

FIFRA directs EPA to restrict or deny the registration of any pesticide if the risks outweigh the benefits or if there are unreasonable adverse effects on humans or the environment. QACs are also regulated under the Food Quality Protection Act (FQPA), which sets more stringent safety

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<sup>1</sup> CBC represents over 40 manufacturers, formulators, and suppliers of antimicrobial pesticides.

standards for pesticide residues on food. EPA, even with recent cuts to its resources, is best equipped to review the large volume of data submitted as part of the Registration Review of QACs and determine the continued safe use of these products in all their currently registered uses.

## II. QAC Uses, Benefits, and Alternatives

QACs are used in a wide range of applications. The TURA process narrowly focused on disinfectant and sanitizer uses, overlooking the broader spectrum of QAC applications. Moreover, the alternatives identified by the Toxics Use Reduction Institute (TURI) are not equivalent in efficacy or scope.

While QAC products are used to kill relatively easy to kill pathogens, such as the Covid-19-causing SARS-CoV-2, they are also used to reduce and kill many other pathogens, including harder-to-kill public health threats. In the analysis of available alternatives to QAC products, the Toxic Use Reduction Institute's fact sheet<sup>2</sup> failed to consider that the listed alternatives are not able to kill the same spectrum of pathogens that QACs are EPA-registered and tested to kill. Other alternatives, such as aqueous ozone, are not even used as hard surface disinfectants. TURI also lists non-chemical alternatives, steam and UV light, which are not reviewed by EPA and evaluated for their ability to kill pathogens. During the height of the Covid-19 pandemic, the proliferation of non-chemical "devices" that made claims to kill public health pathogens created additional public health concerns and generated a large number of enforcement actions against manufacturers and sellers of such devices. TURI failed to show that there are, in fact, safer and equally effective alternatives for QAC products used as disinfectants and sanitizers.

It is critical to use EPA-registered disinfectants and sanitizers in accordance with the EPA-accepted label to help avoid instances of overuse and misuse. Recent data show that sales of disinfecting products have declined since the pandemic-era peak and businesses have discontinued many of the frequent applications of disinfectants to hard surfaces and public spaces that were considered necessary before more information about the behavior of the SARS-CoV-2 virus on surfaces was well-understood. CBC, together with federal and state regulatory agencies and impacted stakeholders, worked to amplify information on the proper use of disinfecting and sanitizing products through the EPA's Pesticide Product Dialogue Committee (PPDC) Emerging Pathogens Work Group and Emerging Pathogens Implementation Committee.<sup>3</sup>

QACs are versatile and used in a wide variety of applications beyond disinfectants and sanitizers. Many of these uses are also regulated by EPA as pesticidal uses, including preservation of articles, preservation in industrial processes, water treatment, and wood preservation. While the TURA law exempts uses of listed chemistries in articles and water treatment from reporting requirements, adding these QAC chemistries to the TURA list will likely have a broad, negative impact on all their critical uses.

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<sup>2</sup> <https://www.turi.org/publications/alternatives/>

<sup>3</sup> [https://www.epa.gov/system/files/documents/2024-11/final-report-ppdc-epic\\_october-22-2024pdf.pdf](https://www.epa.gov/system/files/documents/2024-11/final-report-ppdc-epic_october-22-2024pdf.pdf)

The TURA list is used by regulators in other states when examining chemistries that should be further regulated and/or restricted. While the TURA process identified some limited alternatives for uses of QACs in disinfecting and sanitizing products, there was no examination of available alternatives for other uses of QACs. This is problematic as it fails to recognize that for many uses of QACs, there are limited alternatives available that perform the same critical functions. Should the proposal to list DDAC and ADBAC on the TURA list proceed, it is unclear how Massachusetts will clearly communicate that TURI only examined a narrow set of QAC uses.

### **III. Inappropriate Use of TURA to Address QACs**

Listing DDAC and ADBAC on the TURA list is not an appropriate or effective solution to the concerns raised by the TURA Administrative Council about the use of QACs as disinfectants and sanitizers.

In recent comments to EPA<sup>4</sup>, the Toxic Use Reduction Institute stated TURA is intended to encourage large-quantity chemical users in the state to “examine innovation opportunities to reduce toxic chemical use by adopting safer processes or inputs.” For other chemistries listed under TURA, including those included on EPA’s Toxics Release Inventory (TRI), usage is primarily limited to industrial facilities, and the goal is to encourage those facilities to reduce the use of the listed chemistries. QACs are neither listed on the TRI nor subject to the Comprehensive Environmental Response, Compensation, and Liability Act. For most other chemistries listed under TURA, EPA has already determined that these chemistries are hazardous and therefore additional mitigations are needed to address industrial uses and exposure.

TURI further states in comments to EPA that the program “focuses on identifying the reasons why chemicals are used and wastes are generated. The focus is on protecting human and environmental health by reducing or eliminating the use of toxics wherever possible.” In the case of DDAC and ADBAC, TURI only examined a subset of uses and failed to identify alternatives that could be utilized by the large-quantity users of DDAC and ADBAC in the state.

Applying TURA to QACs misrepresents the nature of their use and regulatory context. TURA’s industrial facility fee-based approach is ill-suited to address the nuanced public health considerations and uses of QACs.

### **IV. Conclusion**

Quaternary ammonium compounds are an important class of antimicrobial pesticides. In many disinfecting uses, QACs are among the only pesticides with the safety profile to be used in low doses where there may be food contact and are among the only products to kill critical pathogens in hospital settings. Maintaining a diverse arsenal of antimicrobial chemistries is vital for public health and antimicrobial resistance management.

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<sup>4</sup> EPA-HQ-OPPT-2024-0507-0013\_attachment\_1.pdf

September 11, 2025

Page 4

CBC urges the Council to reject the proposed listing and instead focus on more effective public health messaging to educate on the proper use of antimicrobial pesticide products according to their label instructions.

Please contact me with any questions or to discuss these comments further ([Anastasia\\_Swearingen@americanchemistry.com](mailto:Anastasia_Swearingen@americanchemistry.com) or 202-249-6505).

Sincerely,

A handwritten signature in black ink, reading "Anastasia Swearingen". The signature is fluid and cursive, with the first name "Anastasia" being more prominent and the last name "Swearingen" following in a similar style.

Anastasia Swearingen

Executive Director

American Chemistry Council Center for Biocide Chemistries

September 12, 2025

Secretary Rebecca Tepper  
Executive Office of Energy & Environmental Affairs  
Attn: TURA Program – 301 CMR 41 Amendments  
100 Cambridge Street, Suite 900  
Boston, MA 02114

**Re:** Support for Proposed Amendment to 301 CMR 41.03—Listing DDAC and ADBAC  
Quaternary Ammonium Compounds

Dear Secretary Tepper and Members of the TURA Administrative Council,

On behalf of the Green Science Policy Institute, we are writing in support for the proposed amendment to list didecyl dimethyl ammonium chloride (DDAC) and alkyl dimethyl benzyl ammonium chloride (ADBAC) under the Massachusetts Toxics Use Reduction Act (TURA). These chemicals, part of the larger family of quaternary ammonium compounds (quats), are widely used in soaps, wipes, sprays, and other cleaning and disinfectant products. However, many of these uses are unnecessary or readily replaceable and scientific evidence reveals significant risks to human health and the environment.

### Health Concerns

Quats are recognized as a chemical class with serious health concerns.<sup>1</sup>

- **Reproductive and Developmental Harm.** In laboratory studies, mice exposed to a mixture of ADBAC and DDAC showed fertility problems.<sup>2</sup> Female mice took longer to get pregnant, had fewer babies per litter, and produced fewer total litters over time. Male mice exposed to the same mixture had reduced sperm concentration and motility. Another study found a substantial increase in neural tube defects in baby mice whose mothers were exposed to quat mixtures.<sup>3</sup>
- **Neurological Harm.** A 2024 paper found that quats can kill oligodendrocytes, brain cells that produce a protective layer around nerve cells.<sup>4</sup> Disruptions in oligodendrocyte production have been linked to neurological disorders like multiple sclerosis and autism.
- **Respiratory Problems.** The Association of Occupational and Environmental Clinics classifies ADBAC and DDAC as respiratory sensitizers and asthmagens. Among healthcare workers, use of quat-based products is linked to higher rates of asthma, COPD, and other breathing problems.<sup>5,6</sup>
- **Cellular and Mitochondrial Damage.** Laboratory studies show that ADBAC and DDAC disrupt mitochondria (the powerhouses of our cells) at very low concentrations.<sup>7</sup> This disruption reduces energy production and increases harmful reactive oxygen species. A high-throughput screen of 1,600 antiseptics, additives, and drugs, and found that quats “were the most mitochondrially toxic class.”<sup>8</sup> These studies also find that quats interfere with cholesterol production, which is essential for proper cell membrane function and hormone production. Human blood samples from people with detectable quat levels showed similar cellular disruption, including altered cholesterol pathways, reduced

mitochondrial function, and increased inflammatory markers.<sup>9</sup>

- **Antimicrobial Resistance.** The genes that allow bacteria to tolerate quats frequently occur alongside genes that confer resistance to antibiotics. This means that when bacteria develop tolerance to quats, they often simultaneously acquire resistance to life-saving medicines. Exposure to DDAC at very low concentrations significantly accelerates the transfer of antibiotic-resistance genes between bacteria.<sup>10</sup> Indeed, decades of research has demonstrated that quats are inducing resistance (along with cross-resistance to critical antibiotics) in pathogens of concern like *Listeria*, *Salmonella*, and *Pseudomonas* species.<sup>11</sup>

### Human Exposure

Human biomonitoring studies analyzing blood samples from 43 volunteers found detectable levels of multiple quats in 80% of participants.<sup>12</sup> Quats have also recently been detected in human breast milk.<sup>13</sup> Household dust surveys consistently detect DDAC and ADBAC in homes, daycare centers, and schools, with concentrations correlating to cleaning frequency.<sup>14,15</sup>

The COVID-19 pandemic increased quat use and human exposure. Studies comparing samples collected before and after the pandemic found that median total quat concentrations in human blood doubled following the increase in disinfectant use.<sup>16</sup> This widespread exposure is particularly concerning for vulnerable populations, including pregnant women, children, and people with respiratory conditions.

### Environmental Risks

Quats are washed down sinks, showers, and toilets into wastewater and the environment. Once in the environment, they are known to be persistent, toxic to aquatic life, and interfere with wastewater treatment.

- **Aquatic Toxicity.** Both DDAC and ADBAC are highly toxic to aquatic life at low concentrations, particularly algae and invertebrates. For example, ADBAC can inhibit the growth of algae at a few tens of micrograms per liter. ADBAC has been shown to reduce reproduction and survival in *Daphnia magna*, an indicator species, at very low concentrations.<sup>17</sup> Fish are also affected. ADBAC causes gill damage and oxidative stress in zebrafish at concentrations found in nature, impairing respiration and survival.<sup>18</sup>
- **Environmental Persistence.** Unlike many other cleaning chemicals, quats don't break down quickly in the environment. Their positive charge causes them to stick tightly to sediments and soils, where they can persist for months to years.<sup>19</sup>
- **Wastewater Treatment Interference.** These chemicals wash down the drain, and because wastewater treatment plants are not designed to treat quats, they are released into the environment. Moreover, quats' cationic nature enables binding to sludge biomass, reducing microbial activity critical for nitrogen cycling in treatment plants.<sup>20</sup>

### Unnecessary Uses and Safer Alternatives

In most everyday circumstances cleaning with soap and water is all that is needed. In situations where disinfection is necessary, effective alternatives to ADBAC and DDAC

already exist and are widely available.

- **Safer Alternatives.** Multiple independent studies confirm that hydrogen peroxide, citric acid, and alcohol-based products achieve equivalent or superior pathogen kill rates compared to quat products in many use cases.<sup>21,22</sup> Many alternatives have faster contact times, leave no residues, and pose fewer health risks to users. For facilities seeking to minimize chemical use altogether, technologies like steam cleaning and microfiber cloths can provide effective pathogen reduction without any chemical residues.
- **Unnecessary Uses.** Both the U.S. Food and Drug Administration (FDA) and Centers for Disease Control and Prevention (CDC) say that “antibacterial” hand soaps, most of which contain ADBAC, are no more effective in preventing disease than non-antibacterial soap and water and discourage their use. Quats in laundry sanitizers are also a dubious use that results in leaching of these chemicals during wastewater discharge from residential washing machines.

### **Actions from Businesses and Other Governments**

Given the emerging concerns about this chemical class a number of governments and businesses have taken actions, for example:

- The entire class of quats was identified by the California Environmental Contaminant Biomonitoring Program as a priority chemical and added to California Department of Toxic Substances Control’s Safer Consumer Products Program Candidate Chemicals List.
- The California Department of Toxic Substances Control’s Safer Consumer Products Program is currently considering potentially listing one or more consumer products containing quats as Priority Products.
- California Assembly Bill 916 (Lee), the Safer Soap Act, co-sponsored by Children Now and Women’s Voices for the Earth, proposes to ban the sale of over-the-counter hand soaps and body washes containing two quats: benzalkonium chloride and benzethonium chloride. This Bill been endorsed by more than 20 other public health and environmental organizations.
- The U.S. EPA does not include quats among antibacterial actives on its Safer Chemical Ingredients List.
- The European Union prohibits the use of a number of quats in specific product categories.
- Whole Foods does not allow a number of quats in their beauty and body care and cleaning products.
- Natural Grocers does not allow quats in their cleaning products.

The proposed TURA listing represents an opportunity for Massachusetts to be proactive in addressing this emerging class of harmful and often unnecessary or replaceable chemicals. The amendment will help improve public health, protect vulnerable workers, reduce environmental contamination, and drive innovation. Moreover, as antibiotic resistance becomes an increasingly urgent public health crisis, reducing environmental releases of quats represents an important strategy for preserving the effectiveness of life-saving medical treatments.



Thank you for your consideration of these important public health and environmental protection measures.

Respectfully submitted,

Arlene Blum, PhD, Executive Director, Green Science Policy Institute

Rebecca Fuoco, MPH, Director of Science Communications, Green Science Policy Institute

Anna Soehl, MS, Science and Policy Consultant, Green Science Policy Institute

## References

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<sup>1</sup> Arnold WA, Blum A, Branyan J, et al. Quaternary Ammonium Compounds: A Chemical Class of Emerging Concern. *Environ Sci Technol*. 2023;57(20):7645-7665. doi:10.1021/acs.est.2c08244

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- <sup>15</sup> Cheng Y, Lv Z, Schreder E, et al. Elevated concentrations of quaternary ammonium compounds in childcare centers: A pilot study. *Journal of Hazardous Materials Letters.* 2025;6:100138. doi:10.1016/j.hazl.2024.100138
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It is appropriate to include the Didecyl Dimethyl Ammonium Chloride (DDAC) and Alkyl Dimethyl Benzyl Ammonium Chloride (ADBAC) subgroups of Quaternary Ammonium Compounds (QAC) on the toxic or hazardous substance list. Extensive research supports that these chemicals are hazardous to human health. Specifically ADBAC, also known as benzalkonium chloride, is a skin and respiratory irritant. It likely impacts the immune and reproductive systems. These traits were reviewed extensively in a paper we published in 2023.<sup>1</sup> In addition to the hazard traits listed in the document, there is recent evidence of neurotoxicity and adverse impacts on the gut microbiome. The following is a non-exhaustive highlight of work that has been published since our review.

A study of serum samples from 81 Indiana residents revealed detectable levels of at least one of 18 quaternary ammonium compounds, including ADBAC, in every participant.<sup>2</sup> There is thus a high frequency of human exposure. A 2024 paper in *Nature Neuroscience* identified quaternary ammonium groups in chemicals including DDAC as being particularly, specifically neurotoxic during development.<sup>3</sup> Multiple studies have linked exposure to changes in the gut microbiome.<sup>4,5</sup> In addition to the studies cited in our previous review,<sup>1</sup> additional research has been published indicating links between ADBAC and unwanted impacts on microbes, including cross-resistance to clinically relevant antibiotics and increased virulence.<sup>6,7</sup>

There is thus strong scientific support for the placement of these chemicals on the toxic or hazardous substance list.

- 1 Arnold, W. A. *et al.* Quaternary Ammonium Compounds: A Chemical Class of Emerging Concern. *Environ Sci Technol* **57**, 7645-7665 (2023). <https://doi.org:10.1021/acs.est.2c08244>
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<https://doi.org:10.1371/journal.pone.0305663>

Tiffany Skogstrom  
Executive Director of the TURA Administrative Council,  
Executive Office of Energy and Environmental Affairs,  
100 Cambridge Street, Suite 1020,  
Boston, MA 02114

Thursday, August 7, 2025

Dear Ms. Skogstrom and the TURA Administrative Council:

I am writing in support of adding didecyl dimethyl ammonium chloride (DDAC) and alkyl dimethyl benzyl ammonium chloride (ADBAC) subgroups of Quaternary Ammonium Compounds to the TURA list, amending 301 CMR 41: Toxic or Hazardous Substance List. These two chemical groups are respiratory sensitizers that can cause harm to those who manufacture them, and to those who use them at work to clean and disinfect surfaces. They affect families from home use, and harm the environment resulting in exposures to the general public in air, on surfaces and in water. These additions will require that companies that use large quantities “evaluate their operations, plan for pollution prevention, and report on the results each year.”<sup>1</sup>

## **SUMMARY**

Adding DDAC and ADBAC to the TURA list will promote conscious efforts to responsibly use these antimicrobial products only where they are needed, to enhance oversight and industrial hygiene controls on the job, and encourage public education about benefits and risks of these chemicals. This paper focuses on the occupational respiratory hazards but includes references to scientific literature that describe the range of emerging health effects and concerns about these chemicals.

## **INTRODUCTION**

This testimony includes summaries of state based sentinel surveillance of work-related asthma (WRA) from 1993-1997 in four states (Massachusetts, California, Michigan, New Jersey) and from 1998-2012 in five states (New York added to previous four). Both datasets include WRA surveillance conducted by the Occupational Health Surveillance Program in the Massachusetts Department of Public Health, where I was working as an industrial hygienist, reviewing interviews, investigating select workplaces and

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<sup>1</sup> <https://www.mass.gov/guides/massdep-toxics-use-reduction-program>

exposures, and serving as one of the authors of two peer reviewed journal articles describing this work.<sup>2 3</sup>

In addition, this testimony will summarize peer-reviewed articles that support these public health findings regarding adverse health effects of quaternary ammonium compounds and respiratory harm, and describe increased use and risks during COVID, accumulation in humans, contributions to antimicrobial resistance, and potential developmental, reproductive and metabolic disruptions.

## **SENTINEL SURVEILLANCE**

The Centers for Diseases Control and Prevention (CDC), National Institute for Occupational Safety and Health (NIOSH) supports state-based public health surveillance of individuals who develop Work-Related Asthma (WRA), documenting their respiratory disease as sentinels of potential harm to many similarly exposed workers.<sup>4</sup> In these systems physicians and other healthcare providers inform state surveillance programs about persons who developed WRA, so that each individual with a respiratory illness can serve as a warning about conditions that created a diagnosed disease and alert employers and employees regarding conditions on the job.<sup>5</sup> This tracking of WRA started in four states in 1993 to learn about the industries, occupations and chemicals associated with developing or worsening asthma among workers. An additional state participated in NIOSH-funded sentinel surveillance in the later time period (1998-2012). Currently, NIOSH funding supports four states, including Massachusetts, to conduct WRA surveillance.

The Association of Occupational and Environmental Clinics (AOEC) established criteria for designating chemicals as respiratory sensitizers, capable of causing asthma in persons who never had asthma before, and exacerbating asthma among adults who had underlying asthma.<sup>6</sup> Chemicals that met one of two major criteria or two of four minor criteria, including publication in peer-reviewed journals were designated

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<sup>3</sup> Rosenman K, Reilly MJ, Pechter E, Fitzsimmons K, Flattery J, Weinberg J, Cummings K, Början M, Lumia M, Harrison R, Dodd K, Schleiff P. 2020. Cleaning Products and Work-Related Asthma, 10 Year Update. *Jour Occup Env Med* 62(2):130-137.

<sup>4</sup> CDC, NIOSH, Work-related Asthma Reporting Guidelines. <https://www.cdc.gov/niosh/surveillance/respiratorydisease/asthma-reporting.html> [Accessed 8/2/25]

<sup>5</sup> Jajosky RA, Harrison R et al. 1999. Surveillance of work-related asthma in selected US states using surveillance guidelines for state health departments—California, Massachusetts, Michigan, and New Jersey, 1993-1995. *MMWR* 48:1-20.

<sup>6</sup> Association of Occupational and Environmental Clinics. [aoec.org](http://aoec.org)

asthmagens.<sup>7</sup> In recent years, the mechanism of induction, as a sensitizer ( $R_s$ ) or cause of Reactive Airways Dysfunction (RADs) was added to the list  $R_{RADs}$ .<sup>8</sup> The states conducting work-related asthma surveillance analyzed the cases and described industries, occupations and chemicals of concern to promote prevention.

During five years, 1993-1997, WRA cases associated with cleaning and disinfecting products accounted for 236 of 1915 cases (12%) in the four states. In Massachusetts, a hospital housekeeper had used cleaning products with phenols and two quaternary ammonium compounds (n-alkyl dimethyl benzyl ammonium chloride and didecyl dimethyl ammonium chloride). She developed asthma, with decrements in her breathing documented with a pulmonary function test, reversed with a bronchodilator. In New Jersey, a hospital housekeeper, exposed to quaternary ammonium compounds developed asthma, was hospitalized for two weeks for respiratory illness. She subsequently quit her job and her asthma symptoms improved after six weeks away from work and with medications.<sup>9</sup>

At that time, two peer-reviewed articles identified quaternary ammonium compounds as sensitizing asthmagens resulting in the designation by AOEC of several quaternary ammonium compounds as asthmagens by sensitization. One investigation documented a positive bronchoprovocation challenge in a worker exposed to a toilet bowl cleaner with a mixture of two quaternary ammonium compounds, and absence of reaction to other cleaning products.<sup>10</sup> Another study described three nurses who developed asthma after being exposed to a cleaning product with benzalkonium chloride, all three with positive peak flow testing at work, and positive specific bronchoprovocation tests to the product with quaternary ammonium compounds, and no reactions to the other cleaning products.<sup>11</sup>

A third peer-reviewed article was added to the record describing a catering school student who developed urticaria and dyspnea within weeks of starting school and using

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<sup>7</sup> Criteria for Designating Substances as Occupational Asthmagens on the AOEC List of Exposure Codes. <https://aoec.org/programs-services/exposure-and-asthmagen-codes/>

<sup>8</sup> <http://www.aoecdata.org/ExpCodeLookup.aspx>

<sup>9</sup> Rosenman KD, Reilly MJ, Schill DP, Valiante D, Flattery J, Harrison R, Reinisch F, Pechter E, Davis L, Tumpowsky CM, Filios M. Cleaning Products and Work-Related Asthma. 2003. *Jour Occup Env Med* 45(5):556-563.

<sup>10</sup> Bernstein JA, Stauder T, Bernstein DI, Bernstein IL. A combined respiratory and cutaneous hypersensitivity syndrome induced by work exposure to quaternary amines. 1994. *J Allergy Clinical Immunol*; 94:257-259.

<sup>11</sup> Purohit A, Kopferschmitt-Kubler MC, Moreau C, Popin E, Blaumeiser M, Pauli G. Quaternary ammonium compounds and occupational asthma. *Int Arch Occup Health* 2000; 73:423-427.

a cleaner with didecyl dimethyl ammonium chloride CAS # 7173-51-5, while ten control students did not develop symptoms.<sup>12</sup>

A 2008 review summarized evidence about quaternary ammonium compounds with sufficient evidence to designate them as asthmagens

Benzalkonium chloride CAS# 8001-54-5; 61789-71-7; 68424-85-1; 68989-00-4; 122-18-9; 122-18-0; 68391-01-5; 8045-22-5; 53516-76-0; 68607-20-5

Dialkyl methyl benzyl ammonium chloride CAS# 73049-75-9

Didecyl dimethyl ammonium chloride CAS# 7173-51-5

Dimethyl ethyl benzyl ammonium chloride CAS# 68956-79-6

Lauryl dimethyl benzyl ammonium chloride CAS# 139-07-1

In 2020, the five states conducting WRA surveillance published an update with an additional 15 years of data (1998-2012) showing a similar proportion of work-related asthma cases associated with cleaning and disinfecting products (12%, 1199/9667). Similar to the previous analysis, the majority of workers affected were female (78%), had new onset asthma (54%), and worked in healthcare (41%). In California, a medical records clerk was frequently exposed to wipes with alkyldimethylbenzylammonium chloride and dimethylethylbenzylammonium chloride used by other workers in the area; she stopped work three years after her initial incident on medical advice and continued to have dyspnea and persistent and recurrent asthma (Supplement, Appendix 2). Of ongoing concern from the findings from all five states were the high proportion of workers with asthma who did not know the specific chemicals to which they were exposed, the clear need for additional surveillance and and prevention efforts to reduce the number of persons exposed to cleaning and disinfecting products ten years later.<sup>13</sup> Policies that promote additional oversight these hazardous chemicals, such as those being considered by the TURA Administrative Council, are crucial in these efforts.

A study compared 22 persons with quaternary ammonium compounds-induced occupational asthma to 289 persons with occupational asthma from other low molecular weight compounds that showed eosinophilic patterns of airway response, supporting evidence of the sensitizing potential of these compounds.<sup>14</sup> Protection from sensitizing chemicals is more difficult compared to irritants because simply reducing the

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<sup>12</sup> Houtappel M, Bruijnzeel-Koomen CAFM, Rockman N. 2008. Immediate type allergy by occupational exposure to didecyl dimethyl ammonium chloride. *Contact Dermatitis* 59:116-117.

<sup>13</sup> Rosenman K, Reilly MJ, Pechter E, Fitzsimmons K, Flattery J, Weinberg J, Cummings K, Början M, Lumia M, Harrison R, Dodd K, Schleiff P. 2020. Cleaning Products and Work-Related Asthma, 10 Year Update. *Jour Occup Env Med* 62(2):130-137.

<sup>14</sup> Miguères N, Debaille C, Walusiak-Skorupa J, Lipińska-Ojrzanowska A, Munoz X, van Kampen V, Suojalehto H, Suuronen K, Seed M, Lee S, Riffart C, Godet J, de Blay F, Vandenplas O; European Network for the Phenotyping of Occupational Asthma (E-PHOCAS). Occupational Asthma Caused by Quaternary Ammonium Compounds: A Multicenter Cohort Study. 2021. *J Allergy Clin Immunol Pract* 9(9):3387-3395. [Abstract]



concentration will not be sufficient to protect against harm and potentially serious morbidity and mortality.

## RESPIRATORY EFFECTS FROM QUATERNARY AMMONIUM COMPOUNDS

In addition to the case stories and sentinel surveillance results, research has supported evidence about the potential of quaternary ammonium compounds to be inhaled and to cause asthma, especially in healthcare, leading to recommendations to decrease unnecessary use of surface antimicrobials where they are not needed for disinfection.<sup>15</sup> Even home cleaning can cause serious hazards and symptoms and disease. Benzalkonium chlorides were detected in the air during short term spray application on surfaces, in all breathing zone samples in 20-minute simulated spray home cleaning;<sup>16</sup> weekly spraying of a number of healthcare disinfectants (including quaternary ammonium compounds) was associated with poorer asthma control;<sup>17</sup> and specifically, spray applications of quaternary ammonium compounds were found to contribute to lung function decline.<sup>18</sup> Use of sprayed cleaning and disinfecting products in residences and schools also contributes to asthma and asthma-like symptoms in children.<sup>19</sup> Asthma-like symptoms in children are associated with increased risk for COPD later in life.<sup>20</sup>

These examples are a sample of the numerous articles and reports about respiratory effects from cleaning and disinfecting in work and home settings, with some limitations on the capacity to identify which quaternary ammonium compounds were implicated in causing the health problems. In addition, evidence about eye and skin irritation, and the

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<sup>15</sup> Quinn MM, Henneberger PK, et al. 2015, Cleaning and disinfecting environmental surfaces in health care: Toward an integrated framework for infection and occupational illness prevention *Am Journal Infect Contr*;43(5):424-434.

<sup>16</sup> Quinn MM, Lindberg JE, Gore RJ et al. 2025. Respiratory quaternary ammonium and volatile organic compound exposures experienced by home care ads during residential bathroom cleaning using conventional and green products. *Annals of Work Exposure and Health* 69:173-190.

<sup>17</sup> Dumas O, Wiley AS, Quinot C et al. 2017. Occupational exposure to disinfectants and asthma control in US nurses. *Our Respiratory J* 50(4).

<sup>18</sup> Clausen PA, Frederiksen M et al. 2020. Chemicals inhaled from spray cleaning and disinfection products and their respiratory effects. A comprehensive review. *Inter Jour Hygiene Environ Health* 229:1-18.

<sup>19</sup> Salonen, H., Salthammer, T., Castagnoli, E., Täubel, M., & Morawska, L. 2024. Cleaning products: Their chemistry, effects on indoor air quality, and implications for human health. *Environment International*, 190, Article 108836. <https://doi.org/10.1016/j.envint.2024.108836>

<sup>20</sup> Bisgaard H, Norgaard S, Sevelsted A, et al. 2021. Asthma-like symptoms in young children increase the risk of COPD. *J Allergy Clin Immunol* 147(2):569-576.e9

capacity of quaternary ammonium compounds to cause dermatitis by immunological mechanisms is beyond the scope of this testimony.<sup>21</sup>

## INCREASED USE AND PERSISTENCE

Concerns about surface contamination with infectious agents has resulted in increased use, exposure to, and absorption of quaternary ammonium compounds. Quaternary ammonium compounds accounted for 47% of products listed by EPA as effective against SARS-CoV-2, with hundreds of products with DDACs and ADBACs enumerated in a recent article.<sup>22</sup> Zheng et al compared quaternary ammonium bioaccumulation in people before and during the COVID-19 pandemic. They described widespread use of quaternary ammonium compounds in consumer, pharmaceutical and medical products, and especially cleaning and disinfecting, with absorption through ingestion and dermal absorption, and risks to children, even if surfaces were disinfected only once per day. They described “frequent detection of QACs in blood collected from the general population . . .”, including specifically dialkyldimethylammonium compounds (DDACs) with significantly higher levels during the COVID epidemic. They also reported detectable air levels in homes, noted increased use in antibacterial handwashing soaps and projected worldwide growth of surface disinfectant use.<sup>23</sup> Quaternary ammonium compounds have subsequently been detected in breast milk, with higher levels detected among those who disinfected more frequently or used sprays instead of wipes.<sup>24 25 26</sup> Calls to Poison Control Centers from exposures to surface disinfectants soared in 2020, indicating health risks in both workplace and nonoccupational settings.<sup>27</sup> Demands for

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<sup>21</sup> Peyneau M, de Chaisemartin L, Gigant N, Chollet-Martin S, Kerdine-Römer S. Quaternary ammonium compounds in hypersensitivity reactions. *Front Toxicol*. 2022 Sep 16;4:973680.

<sup>22</sup> Osimitz TG, Droege W. 2025. Perspectives on safety of quaternary ammonium compounds (QACs). *Jour Toxicol Environ Health, Part B* <https://doi.org/10.1080/10937404.2025.2503784>

<sup>23</sup> Zheng G, Webster TF, Salamova A. 2021. Quaternary Ammonium Compounds: Bioaccumulation Potentials in Humans and Levels in Blood before and during the Covid-19 Pandemic. *Environ Sci Technology* 55:14689-14698.

<sup>24</sup> Boyce JM. 2023. Quaternary ammonium disinfectants and antiseptics: tolerance, resistance and potential impact on antibiotic resistance. *Antimicrob Resist Infect Control* 12(1):32.

<sup>25</sup> Zheng G, Schreder E, Sathyanarayana S, Salamova A. 2022. The first detection of quaternary ammonium compounds in breast milk: Implications for early-life exposure. *J Expo Sci Environ Epidemiol* 32(5):682-688.

<sup>26</sup> Camagay AV, Kendall N, Connolly MK. Quaternary Ammonium Compound Toxicity. [Updated 2023 Jul 15]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK594254/>

<sup>27</sup> Dotson GS, Lotter JT et al. 2020. Setting occupational exposure limits for antimicrobial agents: A case study based on a quaternary ammonium compound-based disinfectant. *Toxic Indus Health* 36(9):619-633.

increased control and precautionary measures have been triggered by disinfectant overuse, detection in blood and breast milk, and in residential dust; quaternary ammonium compounds were 331% higher in wastewater in one area with concerns that higher loads may impair effectiveness of wastewater treatment plants.<sup>28</sup> Concerns are rising that increasing levels of quaternary ammonium compounds will contribute to antibiotic tolerance or resistance.<sup>29 30</sup>

Use of quaternary compounds has increased, potential for exposure is widespread—by inhalation, ingestion and dermal contact, persistence has been documented indoors and in the outdoor environment. Most recently, evidence has emerged of reproductive toxicity in animals, including developmental effects, as well as impacts on cholesterol and lipid metabolism, with additional support for the concern about the adverse effects associated with antimicrobial resistance.<sup>31</sup>

Those who manufacture and use these products are more highly exposed and suffer the more severe consequences, but the broad-based use and impact of these chemicals requires immediate action to reduce unnecessary use and seek methods to prevent sensitization, respiratory and dermal irritant effects, reproductive harm, antibiotic resistance and environmental persistence with potential unpredictable harm to flora, fauna and wastewater treatment.

Thank you for considering this information in your deliberations. Please feel free to contact me with any questions or comments.

Elise Pechter MAT, MPH, CIH (ret)  
111 Perkins Street  
Jamaica Plain, MA 02130  
917 477-9650  
Elise.Pechter@gmail.com

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<sup>28</sup> Mohapatra S, Yutao L, Goh SG et al. 2023. Quaternary ammonium compounds of emerging concern: Classification, occurrence, fate, toxicity and antimicrobial resistance. *Journal Hazard Materials* 445:130393.

<sup>29</sup> Boyce JM. 2023. Quaternary ammonium disinfectants and antiseptics: tolerance, resistance and potential impact on antibiotic resistance. *Antimicrob Resist Infect Control* 12(1):32.

<sup>30</sup> Kim M, Weigand MR, Oh S, Hatt JK, Krishnan R, Tezel U, Pavlostathis SG, Konstantinidis KT. Widely Used Benzalkonium Chloride Disinfectants Can Promote Antibiotic Resistance. 2018. *Appl Environ Microbiol* 84(17):e01201-18.

<sup>31</sup> Arnold WA, Blum A, Brandon J et al. 2023. Quaternary Ammonium Compounds: A Chemical Class of Emerging Concern. *Environ Sci Technology* 57:7645-7665.

**From:** [Dianne Plantamura](#)  
**To:** [Skogstrom, Tiffany \(EEA\)](#)  
**Subject:** TURA list  
**Date:** Monday, September 8, 2025 3:54:03 PM

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**CAUTION: This email originated from a sender outside of the Commonwealth of Massachusetts mail system. Do not click on links or open attachments unless you recognize the sender and know the content is safe.**

Please add a substance category of Didecyl Dimethyl Ammonium Chloride (DDAC) and Alkyl Dimethyl Benzyl Ammonium Chloride (ADBAC) subgroups of Quaternary Ammonium Compounds to the TURA List.

Dianne Plantamura  
22 Mill St. Groveland MA

**Sent from my iPhone**

**From:** [Reibstein, Richard](#)  
**To:** [Skogstrom, Tiffany \(EEA\)](#)  
**Subject:** Comment on Quarternary Ammonium Compounds  
**Date:** Friday, September 12, 2025 11:20:02 AM

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**CAUTION: This email originated from a sender outside of the Commonwealth of Massachusetts mail system. Do not click on links or open attachments unless you recognize the sender and know the content is safe.**

To the TUR Administrative Council:

It has always been the practice that when EPA determines a chemical is of concern, that we in the state take notice. It is also the practice to go through our own careful scientific evaluation. Both of these things have happened with respect to the QACs under consideration and this should be honored. These compounds are of concern and regulated entities using them should be doing so with care. That is what the result of adding these chemicals to the Toxic and Hazardous Substances List will be. Some will say that this will be of some significant economic harm. The additions of chemicals to the list in the past have not harmed companies, but have generally led to them using the materials with more care. The community learns more about where and how the chemicals are used. Raising consciousness of safer alternatives as well as using such chemicals with more care, is what happens when a chemical is named to the list. There are some economic effects but they are not only vastly outweighed by the benefits, but for many they are very shortlived, and when the company has learned to use the chemical more efficiently, and/or about safer alternatives to its use, it is invariably better off for having done so. I encourage you to move forward with this designation.

Thank you.

Richard Reibstein  
Senior Lecturer, Environmental Law and Policy  
Dept. of Earth and Environment  
College of Arts and Sciences  
Boston University



September 11, 2025

Tiffany Skogstrom  
Executive Director TURA Administrative Council,  
Executive Office of Energy and Environmental Affairs,  
100 Cambridge Street, 10th Floor  
Boston, MA 02114  
(by email: [tiffany.skogstrom@mass.gov](mailto:tiffany.skogstrom@mass.gov))

RE: Proposed amendments to add DDAC and ADBAC to the TURA Toxic or Hazardous Substance list

To the Executive Office of Energy and Environmental Affairs:

**Women's Voices for the Earth strongly supports the amendments to add Didecyl Dimethyl Ammonium Chloride (DDAC) and Alkyl Dimethyl Benzyl Ammonium Chloride (ADBAC) to the Toxic or Hazardous Substance list.**

Women's Voices for the Earth is a national environmental health organization that drives action towards a future free from the impacts of toxic chemicals. We represent our numerous members in Massachusetts as well as around the country. We have worked specifically on the issue of toxic chemicals found in cleaning products, with a focus in recent years on the toxic impacts of quaternary ammonium compounds like DDAC and ADBAC.

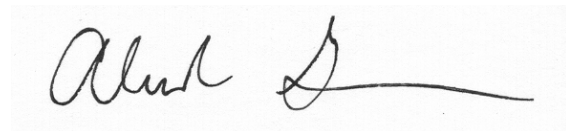
We are especially concerned about the respiratory impacts of these chemicals, especially given the many epidemiological studies demonstrating increased risk of occupational asthma and COPD in cleaning workers and healthcare workers exposed to products containing ADBAC and DDAC. We are also very concerned about the potential reproductive health hazards associated with exposure to these chemicals also found in the scientific literature. Particularly vulnerable populations include women of reproductive age and women of color who do the majority of both household and occupational cleaning in the U.S.

The COVID epidemic heightened our concerns considerably as use of disinfectant products containing DDAC and ADBAC skyrocketed in response. While the usage has likely declined from its peak, there still remains the erroneous public belief that strong

disinfectant products containing chemicals like DDAC and ADBAC are necessary to protect health. We learned from the epidemic however, that this is not the case. The overuse of disinfectants was often an unnecessary show of “hygiene theater” inspired by cleaning product manufacturers, rather than a science-backed action that actually prevented the spread of infection in homes or public spaces.

As there are several available, effective and much safer alternatives to DDAC and ADBAC, such as hydrogen peroxide, ethanol and citric acid, we believe DDAC and ADBAC are very appropriate candidates to be added to the Toxic or Hazardous Substance list.

Thank you for your consideration of these comments.

A handwritten signature in black ink, appearing to read "Alex S.", with a long horizontal flourish extending to the right.

Alexandra Scranton  
Director of Science and Research  
Women's Voices for the Earth



September 11, 2025

Ms. Tiffany Skogstrom  
Executive Director of the TURA Administrative Council  
Executive Office of Energy and Environmental Affairs  
100 Cambridge Street, Suite 1020  
Boston, MA 02114

Dear Ms. Skogstrom:

Thank you for the opportunity to comment on the potential listing of certain quaternary ammonium compounds on the state Toxic and Hazardous Substances list.

Clean Water Action/Clean Water Fund is a national environmental nonprofit working at the national level and in 12 states to advance policies that protect human health and the environment. In Massachusetts, Clean Water Action facilitates the Alliance for a Healthy Tomorrow, a coalition of over 60 public health, environmental, and civic organizations advocating for a precautionary approach to toxic chemicals.

During the pandemic, Clean Water Fund conducted a series of workshops on "Safe Cleaning and Disinfecting in the Age of Covid." The presentations were conducted in English, Spanish and Portuguese. We worked with Massachusetts Coalition of Occupational Safety and Health and the Brazilian Cleaning Cooperative to reach audiences of personal care attendants, home health aides, and professional cleaners.

At the workshops, I was struck by the number of workshop attendees who mentioned that they or their children had respiratory and skin issues of the type that may be linked to quats. Many expressed concerns about their reproductive health, as well. Most of these individuals were Latina women of reproductive age.

We support the listing of two subclasses of quaternary ammonium compounds--Didecyl Dimethyl Ammonium Chloride (DDAC) and Alkyl Dimethyl Benzyl Ammonium Chloride (ADBAC)—to the Toxic and Hazardous Substances List. I did not attend all the Science Advisory Board (SAB) meetings where quats were discussed, but, at the two meetings I did attend, I was impressed with the depth of research, the expertise of board members, and the thorough research and preparation of the scientific literature by Toxic Use Reduction Institute staff and several board members.

Industry representatives participated in the meetings I attended and were given the opportunity to speak. From what I observed, industry perspectives and information were heard, discussed and considered in making the final determination of sufficient hazard to add quaternary ammonium compounds to the Toxic Use Reduction Act (TURA) chemical list.

The justification for listing QACs includes their action as a sensitizer and asthmagen, and their corrosivity when used in more concentrated forms. While the SAB did not rely on emerging evidence of

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developmental/reproductive effects, they expressed concerns over this, as well as the potential for environmental effects.

As a member of the TURA Advisory Committee, I also attended a meeting where TURI staff presented summaries of the SAB work and their policy analysis. Both Advisory Committee members and industry representatives had an opportunity to provide input and ask questions. I have also attended other SAB meetings over the past several years, particularly the meetings where carbon nanotubes and nanofibers were presented. In these discussions as well, I observed detailed review of literature, multiple meetings to discuss the strength of available research, and a strong process to ensure that recommendations followed the weight of scientific evidence.

I am firmly convinced of the importance of adding this category to the TURA list. The literature does suggest that we are close to a boundary for aquatic effects from QACs. For one example of paper citing concerns, please see: William Arnold et al, "Quaternary Ammonium Compounds: A Chemical Class of Emerging Concern" *Journal of Toxicology and Environmental Health*, 2023 at: <https://pubs.acs.org/doi/10.1021/acs.est.2c08244>. It is worth noting that the authors of this article include some of the most prominent researchers in the field of environmental health and toxicology.

Adding QACs to the state's Toxic and Hazardous Substances list does not prevent their use but does raise awareness and provide the state with important information about use and release.

Given the Administration's stated commitment to environmental justice, it is especially important that the Council not shy away from listing chemicals that are widely used but disproportionately harm lower income, immigrant, and Latino/a workers.

Thank you for considering these comments.

Sincerely,



Laura Spark  
Environmental Health Program Director