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Dear Committee Secretary,

Stroke Foundation's supplementary response to the Senate Standing Committees on Community Affairs Inquiry into the Impact of microplastics and other toxics on human health.

Stroke Foundation welcomed the opportunity to contribute to the Senate Standing Committee's inquiry into the impact of microplastics and other toxics on human health by appearing in front of the Committee on 27 March 2026 (represented by Dr Lisa Murphy, Stroke Foundation Chief Executive Officer).

This written submission is provided in addition to Dr Murphy's comments at the hearing, and is a concise summary of current evidence pertaining to microplastics and stroke health, with particular relevance to sections C and H of the Inquiry's terms of reference:

- (Section C) cardiovascular impacts, including links between microplastic accumulation in arterial plaque and increased risks of heart attack, stroke and cardiovascular mortality;
- (Section H) the adequacy of current research, monitoring and measurement standards for microplastic contamination in Australia.

Executive Summary

Plastics pollution is a global issue of growing urgency. International bodies, including the World Health Organisation (WHO), have issued calls to action to address the risks posed by plastic contamination, and Australia is a signatory to these international commitments. Despite this, Australia currently lacks a dedicated national strategy to address the specific and emerging threats to human health posed by micro- and nanoplastics.

Microplastics (plastic particles smaller than five millimetres in diameter) and nanoplastics (roughly 5,000 times smaller than microplastics, with particle size up to 1,000 nanometres) are now ubiquitous in the environment and the food chain. Human exposure occurs through ingestion, inhalation and/or dermal contact, making cumulative exposure to these toxics effectively unavoidable.

Critically, microplastics have been detected in a range of human tissues, including the placenta, lungs, liver, breast milk and blood. A rapidly emerging body of scientific evidence now links micro- and nanoplastics contamination to long-term health risks including metabolic disturbances, adverse immune inflammatory responses, neurotoxicity, endocrine disruption, reproductive disorders, developmental abnormalities, carcinogenicity, and cardiovascular disease, including stroke. Microplastics have been identified in the atherosclerotic plaques lining arterial walls and in the blood clots (thrombi) that cause stroke, heart attack and sudden cardiac death. A 2024 study published in the New England Journal of Medicine found that patients with microplastics detected in their arterial plaques had a 4.5-fold increased risk of major cardiovascular events or mortality, including heart attack and stroke, over approximately 34 months of follow-up.

Australia's current approach to plastics management is focused primarily on addressing pollution and waste management of larger plastics (such as bottles and plastic bags) and reducing single-use plastics

(such as straws). There is no specific national strategy addressing the health risks posed by micro- and nanoplastics. This policy gap exists largely because long-term research studies that could determine direct causal impacts of micro- and nanoplastics on human health have not yet been completed, and national standards for safe human exposure levels have not been established.

Whilst a direct causal link between microplastics and stroke has not yet been definitively established, the association between microplastics and cardiovascular disease including stroke is a cause for concern, being biologically plausible and supported by multiple animal, laboratory and human observational studies.

Stroke Foundation believes there is now sufficient evidence to warrant a government response aimed at ameliorating risks micro- and nanoplastics cause to public health. This is particularly important for priority populations likely to be most impacted by microplastics, including communities living proximal to heavy microplastics contaminated areas and waterways, persons employed in industries with greater exposure to microplastics, Aboriginal and Torres Strait Islander communities, and other groups at increased risk to be identified. Stroke Foundation believes micro- and nanoplastics pollution demands a precautionary public health response and decisive government regulatory action.

Stroke Foundation applauds the efforts Australian Government is undertaking into strengthening our health care system, including improving preventative care.

Addressing micro- and nanoplastics, as well as minimising population exposure also aligns with the goals of Australia's National Preventive Health Strategy 2021–2030 and National Strategic Framework for Chronic Conditions 2026-35, both of which specifically identify healthy environments for living as integral determinants for enabling Australians to live healthier and longer lives.

In response to this Inquiry, Stroke Foundation submits the following five recommendations for the Committee's consideration:

Recommendation 1: Establish National Policy Approaches
Be proactive in **establishing national policy approaches** for the emerging environmental pollution and health risks that micro- and nanoplastics pose to health of adults and children, including development of national guidance on safe human exposure limits for adults and children.

Recommendation 2: Apply the Precautionary Principle
Apply the precautionary principle now. Reduce population-wide exposure to microplastics through strengthened regulation and monitoring of micro- and nanoplastics in the environment and food systems.

The precautionary principle should be applied now, consistent with approaches taken by Government for other emerging contaminants such as per- and polyfluoroalkyl substances (PFAS), etc..

Recommendation 3: Identify and Protect Priority Populations
Ensure that **priority populations** most impacted by micro- and nanoplastics are identified, monitored and included in decision making regarding exposure risks. These priority populations will likely include First Nations peoples, communities living near to heavy microplastics contaminated areas and waterways, people employed in industries with greater exposure to microplastics, and others.

Recommendation 4: Embed Humand Health Into Broader Plastics and Pollutions Policies
Embed human health — including emerging evidence demonstrating association between micro- and nanoplastics and stroke and cardiovascular conditions **into broader national policies aimed at reducing plastics use, waste and pollution**. We must adopt a Health in All Policies and a Whole-of-Government approach to this public health issue.

Recommendation 5: Invest in Long-Term Research into Health Impacts of Microplastics

Invest in research into health impacts of microplastics through National Health and Medical Research Council (NHMRC) and Medical Research Future Fund (MRFF) grants to investigate long-term health impacts of microplastics and address current evidence gaps that exist in national and international research into this issue.

Stroke as a public health issue

Stroke is a medical emergency caused by a sudden interruption of blood flow to the brain, either due to a blockage or a bleed, which can lead to damage, loss of brain function or death.

There are an estimated 45,785 stroke events in Australia annually and more than 440,000 survivors of stroke are living in our community.[1] Stroke is the fourth leading cause of death in Australia[2], accounting for around 8,500 deaths in 2024, and is the fourteenth leading individual cause of burden of disease in Australia (2.2 percent of overall burden).[3] Stroke is also amongst the top ten leading causes of death in children.[2]

The lifetime costs associated with strokes that occurred in Australia in 2023 are estimated to exceed $15 billion ($350,000 per person), including healthcare, lost productivity and unpaid carer costs.[1] Research shows that without a concerted effort to improve stroke awareness and prevention, the number of annual stroke events in Australia is expected to reach 72,000 by 2050.[1]

Regional Australians are 17 percent more likely to suffer a stroke than those in metropolitan areas,[4] while hospitalisation and death rates for stroke are 1.1 times higher in people from remote and very remote areas compared with major cities.[5]

More than 80 percent of strokes can be prevented,[6] and stroke prevention remains the most effective means of reducing the impact of stroke in Australia.

Microplastics and Nanoplastics: Definitions and Characteristics

Microplastics are plastic particles smaller than five millimetres in diameter, existing in a variety of forms including beads, fibres and films.[7] Nanoplastics are substantially smaller, with an upper limit of approximately 1,000 nanometres – up to 5,000 times smaller than the largest microplastics.[8] Both micro- and nanoplastics are formed through the progressive breakdown and fragmentation of larger plastic items, such as plastic bags, packaging and other consumer products, as they degrade in the environment.[9]

At the nanoscale, these particles behave very differently in biological systems and represent a particularly concerning sub-category of plastic pollution. Their minute size allows them to penetrate biological membranes and accumulate in human organs and tissues in ways that larger particles cannot.[7]

The health risks associated with exposure to microplastics can vary depending on particle size, shape, chemical composition, pre-existing health conditions and cumulative dose.[10] The most commonly identified polymer types in micro- and nanoplastics include polyethylene (PE), polyvinyl chloride (PVC), polystyrene (PS), polypropylene (PP), polyethylene terephthalate (PET), polyurethane (PU) and polyamide-66 (PA-66).[11]

Ubiquity of Micro- and Nanoplastics and Routes of Human Exposure

Australian and international studies have detected micro- and nanoplastics in indoor air, soil, road dust, freshwater, marine water and throughout the food chain. [12] [13]

Microplastics accumulate in marine sediments and aquatic organisms, particularly filter-feeding species such as oysters, mussels and other shellfish, which concentrate particles during the feeding process. [14]

Human exposure occurs through multiple pathways, including ingestion (estimated at between 39,000 and 52,000 microplastic particles per adult annually) via contaminated food and water or inhalation of airborne particles from the atmosphere (estimated to be between 74,000 to 121,000 particles per adult annually), from sources such as synthetic textiles, road-wear particles, waste incineration amongst others.[15] By mass, the average weekly ingestion by an adult has been estimated at approximately 4.1 micrograms.[16]

Microplastic Accumulation in the Human Body

Microplastics have now been detected in numerous human organs and biological samples. Of particular relevance to cardiovascular disease and stroke, microplastics have been identified in atherosclerotic arterial plaques – the direct cause of ischaemic strokes, as well as in blood clots (thrombi) recovered from patients who have experienced stroke, myocardial infarctions, and deep vein thrombosis.[17] [18]

Microplastics have also been found in arterial wall tissue, including coronary and carotid arteries, [18] [19] and in cardiac tissue obtained during surgery.[19] Beyond the cardiovascular system, microplastics have been detected in the human placenta, cord blood and breast milk; in lung tissue, liver and kidney; and in brain tissue—confirming the capacity of these particles to cross the blood–brain barrier gaining access to the central nervous system and the developing foetal brain.[20] [21] [22] [23] [24] [25]

There is also emerging evidence that nanoplastics may be capable of crossing the skin barrier under certain conditions both as a method of controlled delivery of drugs and other bioagents, but also as unwanted toxins and pollutants or carriers of other toxins into the body, although the clinical significance of dermal absorption requires further investigation.[26] [27]

Microplastics and Stroke

Elevated environmental concentrations of microplastics may contribute to an increased incidence of chronic conditions, including cardiovascular disease, especially in populations residing close to contaminated sources or exposure to greater volumes of toxics through their living or working conditions or consumption of contaminated food and water.[28] [29]

A USA-based study found a higher prevalence of stroke (by 9 percent), type 2 diabetes (by 18 percent), and coronary artery disease (by 7 percent) in geographic counties in closer proximity to highest-microplastics-polluted coastal waters (compared to similar counties with low levels of microplastics pollution).[29]

In the Australian context, it is essential that priority populations (including those mentioned above, as well as Aboriginal and Torres Strait Islander communities) are identified, monitored and included in decision making regarding their exposure risks (as well as industry, pharmaceutical, manufacturing, government and other stakeholders).[13] [14]

Biological mechanisms through which microplastics may contribute to cardiovascular disease include oxidative stress, endothelial cell damage, metabolic disturbances, adverse immune responses, neurotoxicity, reproductive disorders, developmental abnormalities and aggregation of proteins implicated in neurodegeneration.[8] [18] [21] [30]

Despite rapidly expanding research on the association between health effects and micro- and nanoplastics exposure, current evidence is insufficient to support a direct causal link that these toxics cause cardiovascular disease, nor whether the severity of detected heart, stroke and vascular disease is directly correlated to the level of environmental exposure.[23]

Some of the limitations to this evidence base include variability in methodologies for detecting and quantifying micro- and nanoplastics hindering comparability of results; inconsistent protocols limiting

cross-study and real-world comparability of observed results; and lack of long-term longitudinal studies on effects of microplastics on human health.[23] [31] Further investment in research is greatly needed to address these evidence gaps.

Some of the findings most relevant to microplastics and cardiovascular disease include the presence of microplastics material in cardiac and blood vessel walls, as well as inside the plaques (thrombi) that cause stroke.[17] [18] [19] [23]

The Marfella et al. (2024) study[17], published in the New England Journal of Medicine looked at detecting the presence and possible impacts of microplastics by examining 257 patients undergoing carotid endartectomy procedure (removal of atherosclerotic plaque from the carotid arteries to reduce risk of heart attack and stroke). The study found that individuals with microplastics detected in their arterial plaques had a 4.53 times higher risk of heart attack, stroke or death from any cause, compared to patients without microplastics, over an average follow-up period of approximately 34 months. Patients with microplastics in their plaques also had higher markers for inflammation.

Additional findings of importance include the direct detection of microplastics inside the thrombi that cause ischaemic stroke [17] [18] [19] ; the observation that patients with myocardial infarction (heart attack) had significantly higher microplastic burden compared to patients with unstable angina [19]; arteries with plaques showed higher concentrations of microplastics compared to those without plaques[32]; and that higher concentrations of microplastics in examined thrombi has also been associated with more severe stroke, myocardial infarction and deep vein thrombosis.[18]

Environmental Determinants of Health and key Government Strategies

Australian Government has long recognised that there is a close relationship between people's health and the circumstances in which they grow, live, work and play. These factors are called determinants of health, and they include individual behavioural and biological factors (such as a person's age, genetics and sex), as well as broader socioeconomic, structural, cultural living and working conditions; people's social and community networks and many others.

Environmental determinants of health, which encompass both the natural sphere such as the air, waters and diversity of living things, as well as built environment of our cities, roads and infrastructure are essential to sustaining good health.

Ensuring our environment is conducive to healthy living is enshrined in key Australian Government health strategies, mentioned explicitly in both the National Preventive Health Strategy 2021-2030[33], and the recently release National Strategic Framework for Chronic Conditions[34], both of which highlight the importance of clean environment, access to healthy food and safe drinking water, and absence of pollution. Tackling the issue of micro- and nanoplastics now is critical to ensuring all Australians are given the opportunity to have better health and wellbeing, as well as improved quality of life across all stages of life.

Current Australian Government Approaches to dealing with microplastics

Australia's current plastics policy focuses primarily on managing large plastic waste and reducing single-use products. While these initiatives are important, they do not include a dedicated national strategy to address the potential health risks associated with micro- and nanoplastics. This gap largely reflects the absence of long-term research needed to establish clear causal links to health outcomes or to define safe exposure thresholds.

Despite this, Australians are exposed to micro- and nanoplastics daily through their presence in food, water, soil, and air. Waiting for definitive long-term evidence before taking policy or regulatory action risks

underestimating potential harms and may leave our population unnecessarily vulnerable to added risk to health.

In addition, the lack of government guidance on the health implications of microplastics limits individuals' ability to make informed choices to reduce their exposure. This is especially concerning for groups who may face higher levels of risk, including communities in residing near heavily contaminated areas, workers in industries with high exposure to microplastics pollution, and First Nations communities.

There is also a clear precedent for adopting a precautionary approach. The 2025 Senate Select Committee inquiry into per- and polyfluoroalkyl substances (PFAS) concluded that, although a direct causal relationship with adverse health outcomes had not been definitively established, the existing evidence linking PFAS to known biochemical risk factors for cardiovascular disease and other chronic conditions justified precautionary action. The Committee emphasised that public health advice should acknowledge potential risks and recognise that these risks may increase with higher levels of exposure.[35] We believe a similar prudent approach is warranted for micro- and nanoplastics.

We thank the Committee for the opportunity to contribute to this important Inquiry, and applaud its leadership in developing concerted government policy to address the effects of micro- and nanoplastics on the health and wellbeing of Australians.

Yours sincerely

Dr Lisa Murphy
Chief Executive Officer
Stroke Foundation

About Stroke Foundation

Established in 1996, Stroke Foundation is a national charity that partners with the community to prevent stroke, save lives and enhance recovery. We do this through raising awareness, empowering health professionals to deliver high quality, best-practice care to stroke patients, facilitating research, and supporting survivors of stroke. We advocate for better systems, processes and resources to help health professionals deliver world class stroke care.

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