




So Many Injections, So Much Waste: Understanding the Environmental Impact of Intravitreal Injections

Jacob D. Grodsky, MD¹ , Emily M. Schehlein, MD², David F. Chang, MD³, Nimesh A. Patel, MD⁴, Nathan L. Scott, MD, MPP⁵, Emily D. Cole, MD, MPH⁶ , Audina M. Berrocal, MD⁷ , Judy E. Kim, MD⁸, and Geoffrey G. Emerson, MD, PhD⁹, for the ASRS Sustainability Committee

Abstract

Purpose: To understand the environmental burden associated with intravitreal (IVT) injections and propose actionable solutions to mitigate this impact. **Methods:** An analysis of current IVT injection practices was conducted, focusing on packaging waste, energy consumption, the carbon footprint, and disposal processes. Data on the environmental footprint of IVT injections were collected from the literature and industry reports. Sustainable practices were evaluated for their feasibility and impact on reducing waste and emissions. Industry efforts to address these environmental concerns were also surveyed. **Results:** This study found that the packaging of IVT injection medications, especially brand-name drugs, generates considerable waste. In addition, transportation and storage of these medications substantially contribute to carbon emissions. Implementing take-back programs, reducing packaging size, and using reusable or biodegradable coolers could significantly decrease waste. Adopting multidose packaging and streamlining injection practices can reduce both waste and costs. Sustainable practices have the potential for considerable environmental and economic benefits without compromising patient care. **Conclusions:** Addressing the environmental burden of IVT injections requires a multifaceted approach involving many different parties. Collaboration among retina specialists, industry partners, and stakeholders is essential to foster sustainable practices, reduce waste, and minimize carbon emissions. This effort will ensure that our commitment to patient care matches our commitment to environmental stewardship.

Keywords

surgical techniques and maneuvers, systemic conditions and the eye, vitreoretinal surgery, vitreoretinal surgical instruments, instrumentation and devices, retina

Intravitreal (IVT) injections are a cornerstone of retina care and the most frequently performed intraocular procedure worldwide, with an estimated 15 million IVT injections performed annually in the United States alone.^{1,2} This number is expected to surge as the population ages and with emerging IVT injection therapies. As retina specialists, we witness firsthand the transformative power of these injections in preserving sight and enhancing quality of life. However, with widespread use comes significant environmental burden, in particular in the realm of packaging waste and carbon emissions related to transportation, climate-controlled storage, and disposal of medications and packaging.

Although our focus as retina specialists lies in patient care, we also acknowledge the wider implications of climate change for global health. Climate change exacerbates respiratory diseases, increases food-borne and water-borne illnesses, and facilitates the spread of infectious diseases, disproportionately affecting vulnerable populations.^{3–5} The World Health Organization advocates proactive initiatives that reduce waste, minimize carbon emissions, and build a more sustainable future. Ophthalmologists have

responded with remarkable efforts to promote sustainability. Most notably, EyeSustain is a global coalition of eye societies, organizations, and ophthalmologists who are committed to making healthcare delivery more sustainable—both economically and environmentally. EyeSustain now has more than 50 global

¹ Ochsner Health, New Orleans, LA, USA

² Brighton Vision Center, Brighton, MI, USA

³ Altos Eye Physicians, Los Altos, CA, USA

⁴ Massachusetts Eye and Ear Infirmary, Harvard Medical School, Boston, MA, USA

⁵ University of California at San Diego, La Jolla, CA, USA

⁶ University of Michigan, Ann Arbor, MI, USA

⁷ Bascom Palmer Eye Institute, University of Miami, Miami, FL, USA

⁸ UT Southwestern Medical Center, Dallas, TX, USA

⁹ Retina Consultants of Minnesota, Minneapolis, MN, USA

Corresponding Author:

Jacob D. Grodsky, MD, Ochsner Health, Department of Ophthalmology, Division of Vitreoretinal Surgery, 1514 Jefferson Hwy, New Orleans, LA 70121, USA.

Email: jgrodskymd@gmail.com

member society partners who have incorporated sustainability into their educational programming. We draw inspiration from these initiatives and recognize the interconnectedness of sustainable healthcare practices across specialties.

Although focused on IVT injections, this position statement serves as a call to action, not just to our fellow retina specialists and staff, but also to the manufacturers and distributors whose products and services influence our daily work. Our goal is to foster collective responsibility and a strong commitment to change. As stewards of sight, we must also become stewards of our planet, ensuring both clear vision and a clear conscience for future generations.

Reducing Packaging Waste in Intravitreal Injections

IVT injections are encased in excessive layers of packaging, burdening our healthcare system and exacerbating environmental challenges.⁶ Each injection arrives individually packaged in a box with multiple additional layers, such as clamshell containers housing the medication, vials of medication, accompanying syringes and needles for non-prefilled syringe drugs, as well as an instruction for use (IFU) document. Packaging differs significantly among drug formulations; brand-name drugs usually have more packaging layers than compounded bevacizumab, which is often more efficiently packaged by a compounding pharmacy.

Retina specialists purchase IVT injections in bulk yet receive separate IFUs for each individual injection, resulting in substantial, unnecessary waste. These large, redundant, and unnecessary paper pamphlets undergo refrigeration with the medication and are subsequently recycled or discarded, often without being opened. We strongly urge manufacturers to switch to electronic IFUs, in accordance with the American Academy of Ophthalmology, American Society of Cataract and Refractive Surgery, European Society of Cataract and Refractive Surgeons, and EyeSustain 2023 joint position paper on electronic IFUs.⁷

The transportation of medications also produces significant landfill waste, amounting to 190 g per IVT injection.⁶ Smaller packaging that uses compostable (or recyclable) materials and take-back programs for containers and cold packs have been proposed as ideas to reduce procurement waste, and leading manufacturers are beginning to adopt these practices.⁸ In addition to the environmental benefits, decreasing waste can also have significant cost-saving implications.^{9–11}

Methods of Performing Intravitreal Injections

Single-use materials, such as eyelid speculums, gloves, drapes, and masks, are major contributors to medical waste in IVT injections. The rationale of single-use items is often to prevent endophthalmitis. However, sterility and low infection rates can be maintained with many multiuse items without significantly adding to the ecological burden of healthcare.¹² This has been well-documented in the comparison of post cataract surgery endophthalmitis rates at Aravind Eye Hospital (0.02% with

intracameral antibiotics and 0.04% without), where most supplies are reused, with the endophthalmitis rates after cataract surgery in the US.^{13,14}

Studies have quantified physician preferences as well as infection rates associated with additional items used in IVT injection procedures, including masks,^{15,16} drapes,¹⁷ sterile gloves,¹⁸ non-sterile gloves,¹⁹ speculums,^{19,20} and antibiotic prophylaxis.^{19,21–24} In choosing the necessary items for each injection procedure, we should consider the environmental impact of unnecessary waste, which is multiplied by our high IVT injection volumes. Despite the plethora of potential IVT injection administration techniques, the strongest evidence against the risk for endophthalmitis pertains to the use of topical antisepsis and eyelid retraction from the injection site.^{25,26} We encourage our colleagues to reevaluate the necessity of each IVT injection step and supply item, aiming to eliminate those that may be unnecessary without compromising the safety of patients or medical staff.

Treatment Burden and Carbon Footprint

Research underscores that patient travel accounts for approximately 77% of carbon emissions associated with IVT injections.²⁷ Recurring IVT injection treatments for chronic conditions such as macular degeneration and diabetic macular edema result in frequent travel, clinic burden, and environmental impact. Gene therapy and other more durable treatments offer promise for alleviating the burden related to frequent patient visits.

Monetary Benefits of Sustainable Practices

The transition to sustainable packaging and practices offers not only ecological advantages but also financial benefits. By reducing waste, healthcare institutions can realize significant cost savings while diminishing their environmental footprint.^{9–11} Fewer expenses are associated with disposal, waste management, and procurement of single-use materials. Embracing multidose packaging and reusable tools represents a cost-effective approach benefiting physicians, healthcare systems, and industry. Sustainability, therefore, becomes a path to both environmental responsibility and fiscal prudence.

Role of Industry Stakeholders

Manufacturers, distributors, and pharmaceutical companies play a pivotal role in the innovation, production, packaging, and delivery of medications and are essential partners in reducing waste and carbon emissions. Many of these companies have already shown their commitment to more sustainable practices.⁷ We invite our industry partners to engage in a collaborative dialogue to improve sustainability.

Highest Priorities

As we navigate the goal of reducing IVT injection waste, several promising strategies emerge. These possibilities will lessen the environmental burden and harmonize with patient care and economic prudence.

- **Reusable/biodegradable coolers.** A fundamental element in the transportation of medications is the use of cold packs and coolers. We must acknowledge the impact of these single-use, often nonbiodegradable materials on our environment and continue to explore feasible alternatives.²⁸ Some companies are beginning to adopt reusable or biodegradable coolers for shipping medications or using take-back programs, thereby reducing the environmental footprint. Distributors who are still shipping product in single-use Styrofoam coolers should consider joining in this trend.
- **Packaging modifications.** Streamlining clamshell container design can markedly reduce waste.⁶ Certain manufacturers have made significant design modifications, and we encourage industry-wide adoption of these practices. Transitioning from individual dose packaging to multidose packaging offers another opportunity to minimize waste. Bulk packaging, which is used by many compounding pharmacies, would reduce packaging volume, improve shipping efficiency, and decrease costs. In addition, multidose packaging could eliminate the need for an IFU to be included with each injection, further reducing waste.
- **Self-reflection and simplification.** Retina specialists should conduct a critical self-assessment of IVT injection techniques and surgical instrument use with the goal of reducing redundant or sparingly used items.²⁹ Streamlining our process, however, must not compromise safety or patient care.

Conclusions

Retina specialists, staff, and industry stakeholders can work together to reduce carbon emissions and the ecological footprint. Through initiatives such as take-back programs, reusable or compostable packaging, downsized containers, and multidose options, we can cut healthcare costs while contributing to a more responsible healthcare ecosystem. The American Society of Retina Specialists has established a Sustainability Committee to help identify areas for potential change. In closing, we urge retina specialists to likewise seek opportunities to reduce waste. Together, we forge a path toward a future in which patient care and environmental sustainability go hand in hand.

Authors' Note

This position statement has been endorsed by the American Society of Retina Specialists, EyeSustain, European Society of Retina Specialists, and Asia-Pacific Vitreo-retina Society.

Ethical Approval

Ethical approval was not needed for this committee report.

Statement of Informed Consent

Informed consent was not needed for this committee report.

Declaration of Conflicting Interests


The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of the article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iDs

Jacob D. Grotsky  <https://orcid.org/0000-0001-9147-505X>

Emily D. Cole  <https://orcid.org/0000-0002-7114-0030>

Audina M. Berrocal  <https://orcid.org/0000-0002-2446-2184>

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