

Case Study: Plastic Waste Diversion in Dialysis

The Switch to Central Acid Delivery System

Problem

Dialysis clinics designed without a central delivery system rely on the use of 4.5L single use plastic jugs. These plastic jugs have large financial and environmental impacts.

Overview

All dialysis treatments require acid concentrate to form dialysate used during treatment. Dialysis units are typically designed to deliver this acid concentrate in either a single use plastic jug or via a central delivery system (CDS). The shift towards CDS is a sustainability opportunity to mitigate the environmental impact of hemodialysis.

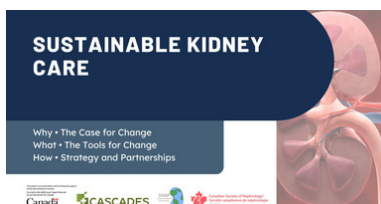


The environmental implications of the use of single use plastic jugs include:

- **Medication Waste:** The use of plastic acid jugs results in unused acid being unnecessarily disposed of down drains. Audits from several dialysis units found that about 10% to 56% of unused acid concentrate remains in the plastic jug at the end of treatment (1-4). The cost of this unused concentrate can vary from region to region, based on contract pricing. For example, at a cost of \$1.00 per litre, the range of loss per treatment is \$0.45 to \$2.52. Alberta Health Services estimated the wastage cost in a 1000 dialysis patient unit is \$260,520 per year.
- **Plastic Waste:** Plastic jugs cannot be reused and even when recycled, nearly all the plastic ends up in the landfill; in Canada only 7% of all plastic waste is recycled.

Note that for existing dialysis centres, retrofitting a CDS may be viewed as challenging and costly. However, Dialysis Management Clinics has shared insight into the process of shifting to primarily CDS for dialysis, highlighting both environmental and cost benefits.

Read the full Sustainable Kidney Care Playbook at [CASCADES](#)



See: Action Area 8 - *Incorporate Sustainable hemodialysis Technologies* in the Sustainable Kidney Care Playbook

A Case Study of Transitioning to Central Delivery System

Dialysis Management Clinics (DMC) operates three community dialysis clinics in the Greater Toronto Area. In 2025 and 2026, DMC successfully transitioned to a central delivery system (CDS) at two of their larger dialysis clinics, their Pickering and Markham sites. These two dialysis sites had operated with single use plastic jugs for over three decades. By transitioning to CDS, DMC was one of the first sites in Ontario to retrofit an existing dialysis unit with a CDS.

The Process

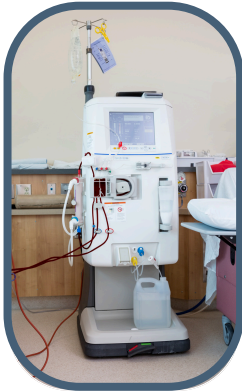
- The two dialysis clinics, together, have 42 dialysis stations (21 in Pickering and 21 in Markham). Prior to installing CDS, they collectively used around 92 single use plastic jugs per day. At full patient capacity, daily use would have been up to 126 plastic jugs per day. This translates to about **28,704 to 39,312 plastic jugs** used per year.
- Between the two sites, around 30% of the acid was left over in each plastic jug, resulting in unnecessary post-treatment waste, and costing the organization an estimated **\$38,750 a year**.
- A business case demonstrated that replacing plastic jugs with a CDS program would be good for both the planet and the organization's finances. After completing a net present value (NPV) analysis, the CDS project had a positive NPV in year 4 after installation.
- For retrofit installation of the CDS, the team at DMC worked with both a water system vendor (where they purchased the CDS equipment), and a Technologist from a Toronto hospital with an existing CDS program to help develop the design and configuration for the retrofit installation. During the planning phase, the team also toured a local satellite unit's CDS program which used the same purchasing vendor.
- Once the CDS was in use, it eliminated the need for plastic jugs for most patients. The system delivered acid concentrate to each dialysis machine via a closed loop system. The patients receive the required amount of acid concentrate needed for their treatment session, preventing any post-treatment wastage.

Dispelling Myths around CDS

Concerns about installing CDS largely stem from early, in-house designs that combined acid and bicarbonate delivery, where bicarbonate systems historically were often problematic.

- **Modern CDS eliminates plumbing-related risk:** Current installations do not use conventional plumbing pipes that corrode over time; instead, they use pressurized tubing similar to a dialysis water delivery loop, with pressure-fitted connections.
- **Redundant pressure monitoring ensures safety:** The CDS continuously measure pressure changes; if a leak occurs, alarms are triggered and acid delivery automatically stops, preventing ongoing exposure or unnoticed leaks.
- **Corrosion is not an issue in current systems:** Acid does not go down the drain in its pure form, preserving facility plumbing and eliminating drain pipe corrosion, with risk limited only to rare, visible issues such as pump wear or leaking quick connectors.
- **Easier to maintain:** CDS fixtures can be installed externally for visual inspection, components such as pumps and quick connectors are easy to swap if needed.

Transition Pathway from Individual Acid Jugs to CDS



1 Dialysis staff stock, organize and distribute 4.5L acid jugs for each dialysis treatment.

BEFORE

2 At the end of treatment, staff discard about 1/3 of the unused concentrate down the drain.

Audits from other units show wastage of unused concentrate of about 35% (2); 33% to 56% (3) ; and 33% (4).



3 Staff dispose emptied plastic jugs for collection.

Although jugs can be placed in the recycling stream, they are typically sent to landfill.

AFTER

5 A pump transfers the concentrate from the 200L barrels to the 1000L holding tanks to then deliver the two primary acid concentrate formulations to each dialysis station.

Dialysis technologists, or a trained designate monitors the CDS periodically to ensure acid concentrate always remains available for treatment. A refiling of the holding tank is performed when tank levels are low.

4 200L barrels are delivered by the vendor, supplying the unit with acid concentrate in their two primary formulations

Acid concentrate from the barrels are transferred into larger holding tanks prior to central acid delivery.



200L Barrels



1000L Holding Tanks

6 **Outcomes**

- 80% reduction in acid concentrate related plastic and medication waste by engaging clinicians and ensuring patient dialysate prescriptions align with the CDS program.
- Realize a \$1.35 savings per treatment for each patient on CDS and a total of \$31,000 annual return on investment (ROI).
- Improved staff satisfaction, workflow, and reduced medication errors and risk of injury.

Challenges and Considerations at DMC

- **Prescriptions:** The benefits of CDS is only realized when nephrologists prescribe patients on one of the two CDS acid formulations. It is unrealistic to expect 100% of patients to be put on CDS, especially since some patients require individualized dialysate prescription that only come in the 4.5L acid jug. As a result, the 80% goal for patients on CDS was set and monitored monthly with the Quality Assurance Committee.
 - If 80% of patients are switched to the CDS, it is projected to divert about 22,963 plastic containers from landfill; and
 - prevents disposal of about 31,000L of end-of-treatment concentrate.
- **Capital Cost:** At the DMC clinic, assuming no change in patient volumes, the program has a 4 year ROI, 2 years for the CDS equipment and 2 years for the installation.
- **Delivery Doors:** The CDS program saved on storage space in the dialysis unit, however, the delivery doors needed to accommodate a skid size delivery. A barrel mover was also purchased to assist with moving barrels around the clinic.
 - Ensuring enough space to install the 1000L holding tanks, as well as space for several 200L barrels and back up acid jugs for emergency use is another consideration.
- **Training:** The dialysis team were trained on how to maintain the system, which include annual preventative maintenance and weekly checks of the dialysis connections to prevent acid crystallization.
- **Re-use:** Since there are no established reuse programs in Canada, the emptied 200L barrels are donated to the community i.e. water storage, planters, dock floats and farm use.

Staff Benefits

At the DMC, it was reported that the CDS reduced nursing workload, saving nursing time - which can potentially be used towards spending more time with their patients; several studies have reported similar outcomes (1,2,7).



“Reducing acid concentrate waste can save health care dollars immediately and in the long-term and reduce the carbon footprint associated with dialysis treatments (3).
- Alberta Health Services”

“Retrofitting a CDS is a feasible sustainability initiative where upfront cost investments can lead to savings within a short-time period. At DMC, had patient volumes been higher, the ROI could have been significantly reduced by months.” - Ethan Holtzer, Director at DMC



Other Examples of Dialysis Units Adopting CDS

St Luke's Hospital, UK

Prior to installing a CDS, a dialysis unit in the UK went through 29,540 plastic jugs and wasted approximately 50,142L of unused concentrate. The installation of the CDS led to emissions and financial savings by avoiding disposal of residual acid waste and plastic waste from the single-use jugs (2).

16 tonnes

CO₂e per year

Estimated carbon savings

163% ROI in 5 years

Dialysis and Renal Transplant Unit, Italy

The 46 Station dialysis unit providing 30,000 hemodialysis treatments in one year determined there was about 12,100L of unused acid concentrate based on the average volume remaining in the jug post-treatment (1).

- The switch to a central delivery system resulted in:

80% reduction in the use of single-use acid concentrate bags that year

Disposal of unused concentrate dropped to

2351L

University Medical Center Utrecht, Netherlands

In 2022, the dialysis centre switched to CDS - prior to the transition, it would dispose of about 5000 plastic jugs per year (6).

Life cycle assessments (LCA) of the two concentrate delivery methods showed that the use of CDS resulted in a:

58% reduction in carbon emissions related to decrease in transportation-related emissions (from reduced weight/load) and less packaging (6).

Dialysis Centre, UK

1 tonne

CO₂e per year

Carbon footprint savings of one dialysis station after the installation of two 3000L storage tanks for CDS.

In the UK, a 30 station dialysis unit that provided about 28,080 treatments per year determined there was about 40,000L of unused concentrate post-treatment wasted annually (4).

CDS Outcome Measures

- The switch to a CDS was associated with an estimated carbon savings of 33,841kg CO₂e per year; equivalent to driving a car for 136,800km.
- These savings are primarily associated with the reduction in manufacturing of plastic containers, transportation, packaging and waste generation.
- Annual cost savings was around £18,400 (~ \$33,000 CAD) - mainly from eliminating post-treatment concentrate waste as each patient now uses only the needed volume per treatment.
- Expected to achieve a ROI from the CDS installation within 3 to 4 years (4).

Dialysis Centre, Saudi Arabia

The switch from 5L single-use plastic jugs to a CDS resulted in:

- **87%** reduction in CO₂ emissions; and
- **95%** reduction in acid concentrate wastage (7).

Regional Dialysis Program, Spain

Determined the LCAs of single-use plastic containers vs plastic bags vs CDS; the measures were based on 15 dialysis centres in Spain (5). Their analysis showed that per treatment:

- The 3.9L containers had the largest carbon footprint; 2.63 times higher than the holding tanks for CDS.
- The production of the containers and plastic waste disposal were the largest contributors to all 3 concentrate delivery formats.
 - It accounted for 77% of the 3.9L containers overall carbon footprint and
 - about 59.6% of the storage tanks carbon footprint (5).

407 tonnes

CO₂e per year

The difference in emissions between the use of plastic jugs over storage tanks. This is equivalent to flying from London to New York 682 times.



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