Real World Examples

PVC Recycling in Peritoneal Dialysis

Nathan Berman Parks
Mexico
INCMNSZ

DISCLOSURES

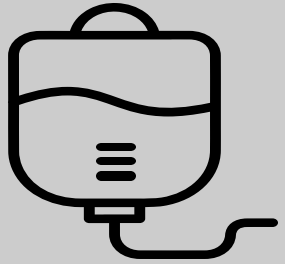
- Co-Founder of RE-PVC A.C


2025

Am J Nephrol 2021;52(2):98-107.c

1,800,000 Tons

1,500,000 Tons



300,000 Tons

IS ALL RRT WASTE MATERIAL THE SAME?

Clinical Waste Generation from Renal Units: Implications and Solutions

Nicholas A. Hoenich,* Robert Levin,† and Catherine Pearce‡

*School of Clinical Medical Sciences, University of Newcastle, and ‡Renal Unit, Royal Victoria Infirmary, Newcastle upon Tyne Hospitals NHS Trust, Newcastle upon Tyne, United Kingdom; and †Renal Research Institute, New York, New York

ABSTRACT

The treatment of end-stage renal disease (ESRD) makes extensive use of presterilized disposable items which, after use, are contaminated by blood. The preferred route of disposal of such items is by incineration. Disposal costs have risen and this increase in costs has not been matched by waste management programs in renal units. Many of the waste items generated also contain polyvinyl chloride (PVC) whose incineration is environmentally sensitive. Furthermore blood tubing sets contain plasticizers such as di(2-ethylhexyl) phthalate (DEHP), which is known to pose health risks to specific groups of patients. The generation of clinical waste in a dialysis unit is analyzed, issues associated with disposal are discussed, and approaches toward a cost-effective, environmentally sustainable clinical waste management program are reviewed.

Seminars in Dialysis—Vol 18, No 5 (September–October) 2005 pp. 396–400

widely practiced for many years in the United States and elsewhere, however, the primary consideration has been financial rather than environmental. When dialyzers are reprocessed, the reduction in waste generated must be set against the environmental health issues associated with the use of chemicals for cleaning and reprocessing of the dialyzer, as well as any potential mortality and hospitalization risks associated with reuse (11–14).

Substitution of Hazardous Materials

Hazardous materials, which require special management and create specific risks to users and the community, should be replaced with less hazardous materials. Waste from dialysis units contains large amounts of PVC. Although there has been a reduction in dioxins and related compounds via incineration, disposal via landfill is associated with the release or leeching of phthalates into the ground, while accidental combustion leads to atmospheric discharges of dioxins and dibenzofurans (15,16).

Polyolefins, a class of materials that includes polypropylene, high- and low-density polyethylene, and polyisobutylene, represent a potentially suitable alternative to PVC. They offer a similar flexibility to PVC, achieved by

from PVC in favor of alternative materials.

Conclusion

Dialysis owes much of its success to the availability and use of prepackaged sterile items, however, the use of such items generates a considerable amount of clinical and nonclinical waste. A dialysis unit treating 100 patients generates 39 metric tons of waste annually, of which a substantial portion is clinical waste. The cost of disposal of such waste is between £180 and £320 per metric ton. Compliance with more stringent environmental requirements will undoubtedly result in further increases in disposal costs. To minimize costs, dialysis units need to review their clinical waste disposal practices and introduce waste management programs. Since much of the waste generated is PVC based, consideration should also be given to the use of alternative materials whose disposal is more "environmentally friendly."

References

Seminars in Dialysis—Vol 18, No 5 (September–October) 2005 pp. 396–400

MacBook Pro

PVC (polyvinyl chloride)

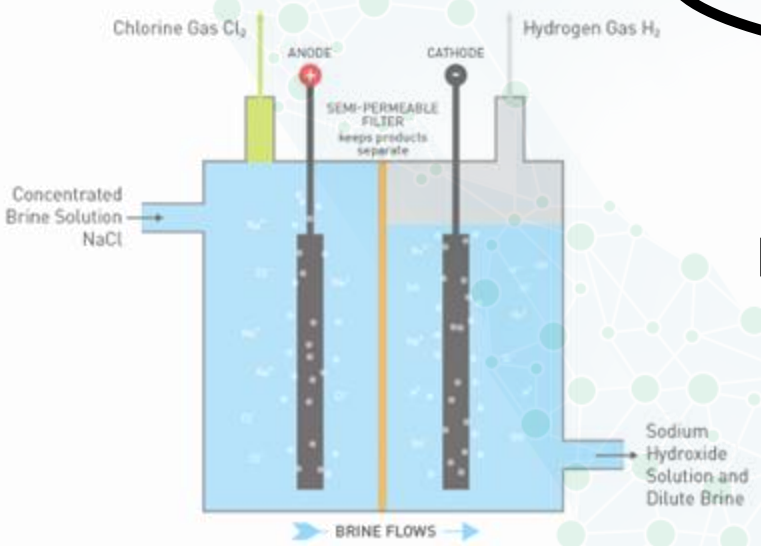
Thermoplastic polymer

Present in over 25% of medical devices

Ranks third in production volume

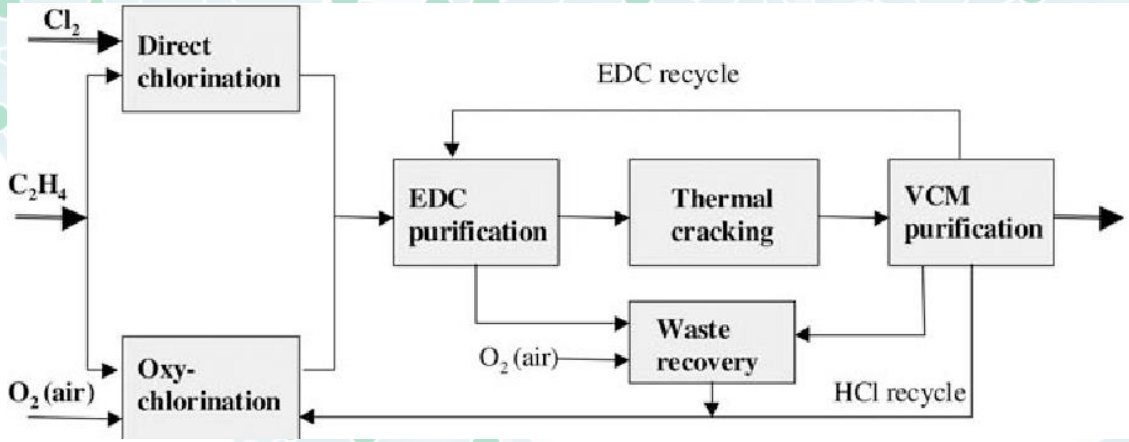
Cl

2

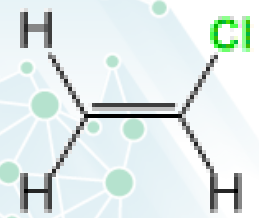


Caustic Soda

Ethylene



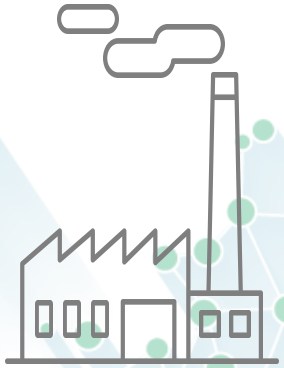
VCM



Monomer

Vinyl Chloride

Vinyl Chloride Monomer ProcessA. C. Dimian, 2008



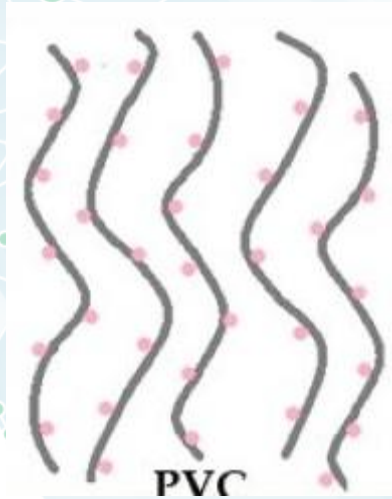
PVC RESIN FACTORY

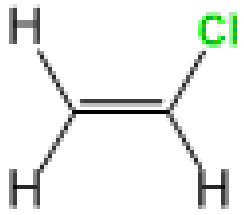
VCM

15 LITER/ Kg PVC

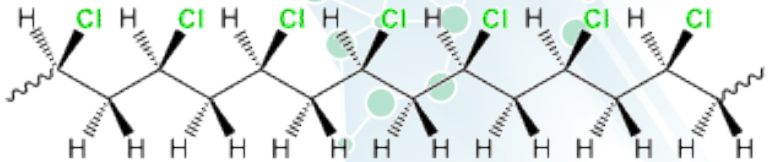
21 KwH/ Kg PVC

CO_2 6 Kg/ Kg PVC

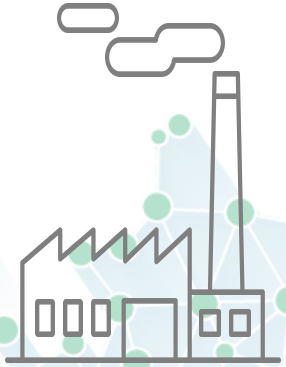




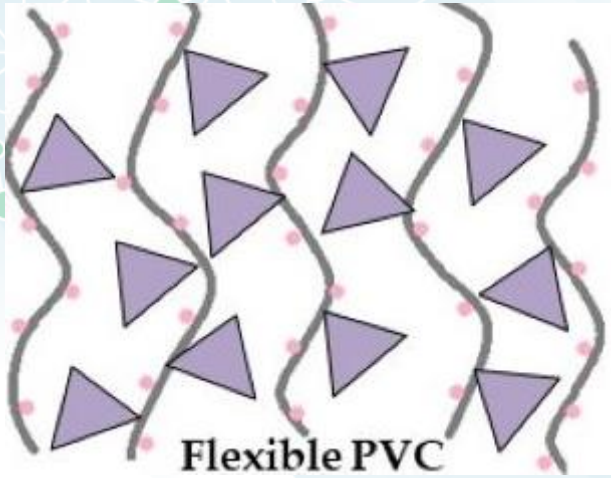
Monomer
Vinyl Chloride



Polymer
Poly Vinyl Chloride (PVC)



THERMOPLASTIC COMPOUND INDUSTRY



Bis(2-ethylhexyl) phthalate (DEHP)

INCINERATION

DIOXIN EMISSIONS

PVC WASTE

MUNICIPAL GARBAGE RECOLLECTION

MUNICIPAL LANDFILL

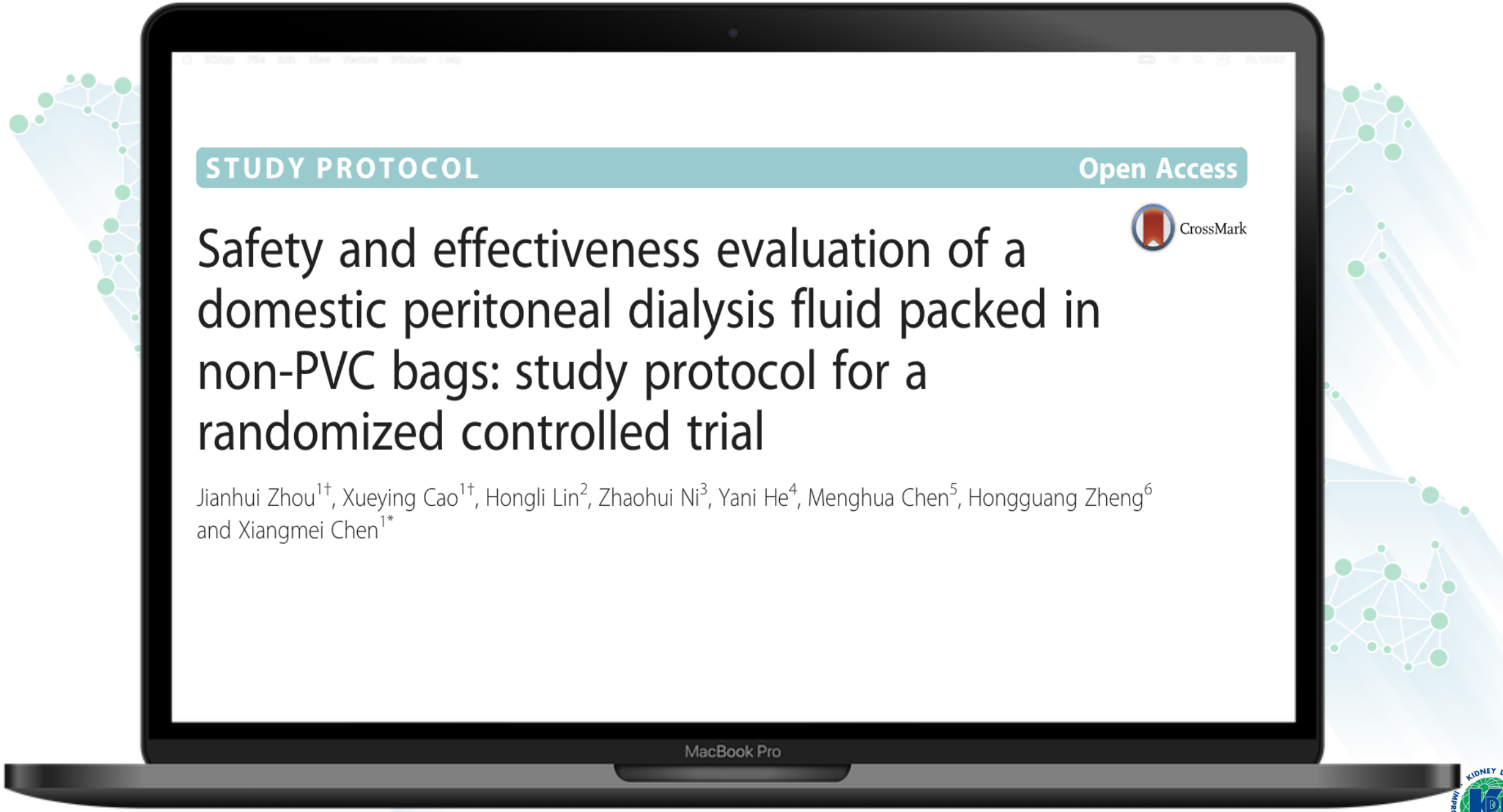
PHTALATE LEACH

MICROPLASTICS

GREENPEACE

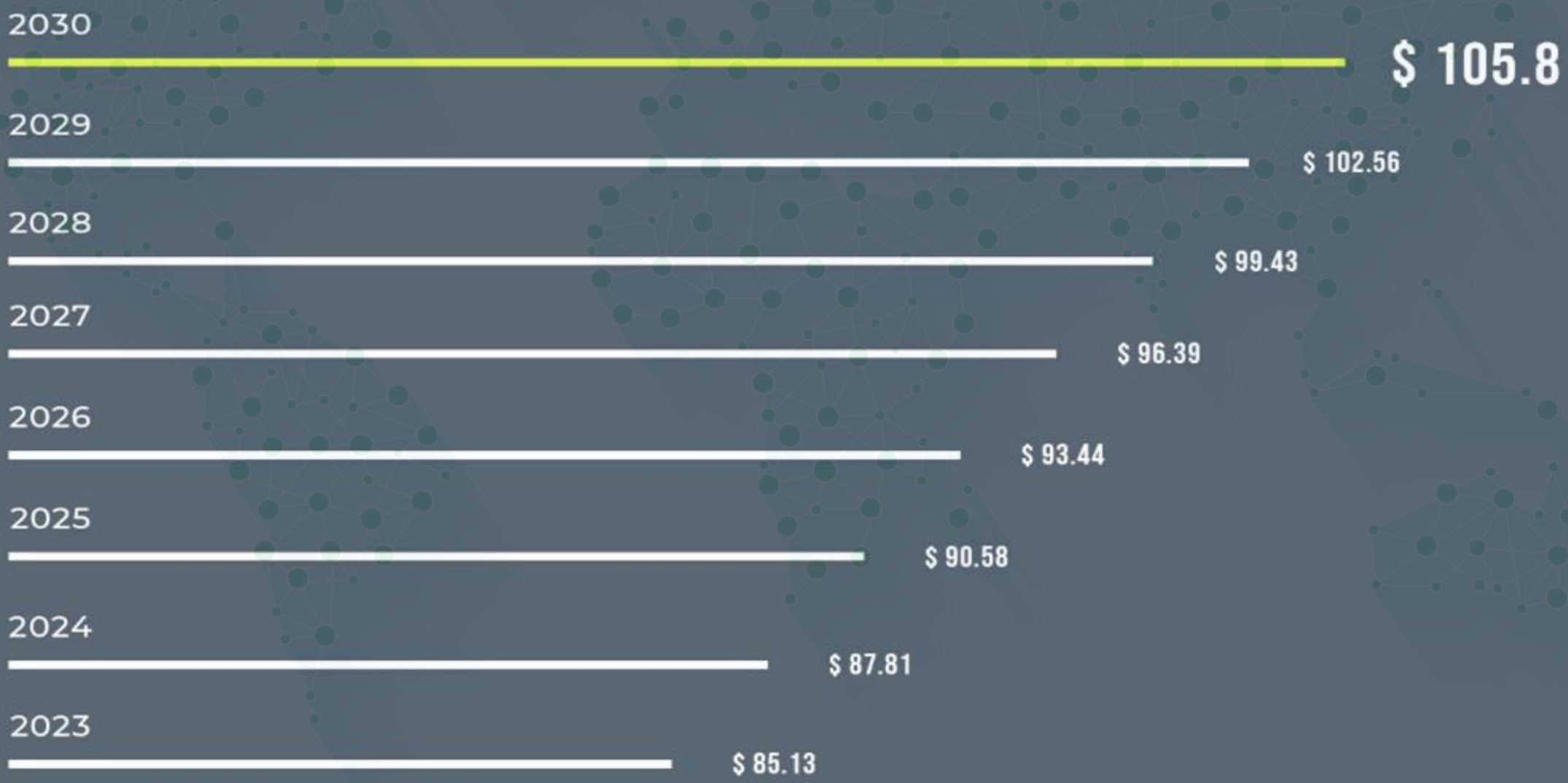
"Poison plastic"

https://www.greenpeace.org/usa/toxics/pvc-free/#:~:text=In%20fact%2C%20this%20commonplace%20plastic,environmentally%20damaging%20of%20all%20plastic


STUDY PROTOCOL
Open Access
Safety and effectiveness evaluation of a domestic peritoneal dialysis fluid packed in non-PVC bags: study protocol for a randomized controlled trial
Jianhui Zhou[1†], Xueying Cao[1†], Hongli Lin[2], Zhaohui Ni[3], Yani He[4], Menghua Chen[5], Hongguang Zheng[6] and Xiangmei Chen[1*]
MacBook Pro

Polyvinyl Chloride (PVC) Market Size, 2021 to 2030 (USD Billion)

PRECEDENCE RESEARCH



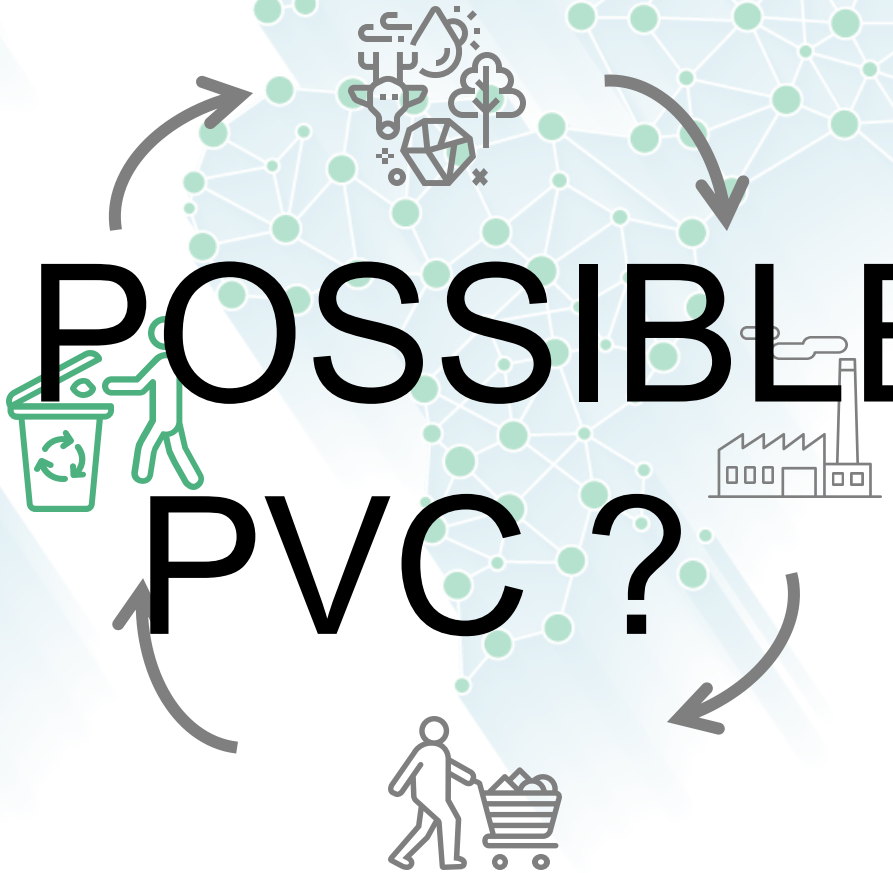
https://www.globenewswire.com/news-release/2022/08/04/2492922/0/en/Polyvinyl-Chloride-PVC-Market-Size-to-Hit-USD-105-8-Bn-by-2030.html

https://www.greenpeace.org/usa/toxics/pvc-free/#:~:text=In%20fact%2C%20this%20commonplace%20plastic,environmentally%20damaging%20of%20all%20plastic

Linear Economy

Linear Economy

Circular Economy



IS THIS POSSIBLE WITH PVC ?

polymers

MDPI

Review

A Brief Review of Poly(Vinyl Chloride) (PVC) Recycling

Krzysztof Lewandowski * and Katarzyna Skórczewska *

Faculty of Chemical Technology and Engineering, Bydgoszcz University of Science and Technology, Seminaryjna 3, 85-326 Bydgoszcz, Poland

* Correspondence: krzysztof.lewandowski@pbs.edu.pl (K.L.); katarzyna.skorczewska@pbs.edu.pl (K.S.)

Abstract: Bearing in mind the aspiration of the world economy to create as complete a closed loop of raw materials and energy as possible, it is important to know the individual links in such a system and to systematise the knowledge. Polymer materials, especially poly(vinyl chloride) (PVC), are considered harmful to the environment by a large part of society. The work presents a literature review on mechanical and feedstock recycling. The advantages and disadvantages of various recycling methods and their development perspectives are presented. The general characteristics of PVC are also described. In conclusion, it is stated that there are currently high recycling possibilities for PVC material and that intensive work is underway on the development of feedstock recycling. Based on the literature review, it was found that PVC certainly meets the requirements for materials involved

Polymers **2022**, *14*, 3035.

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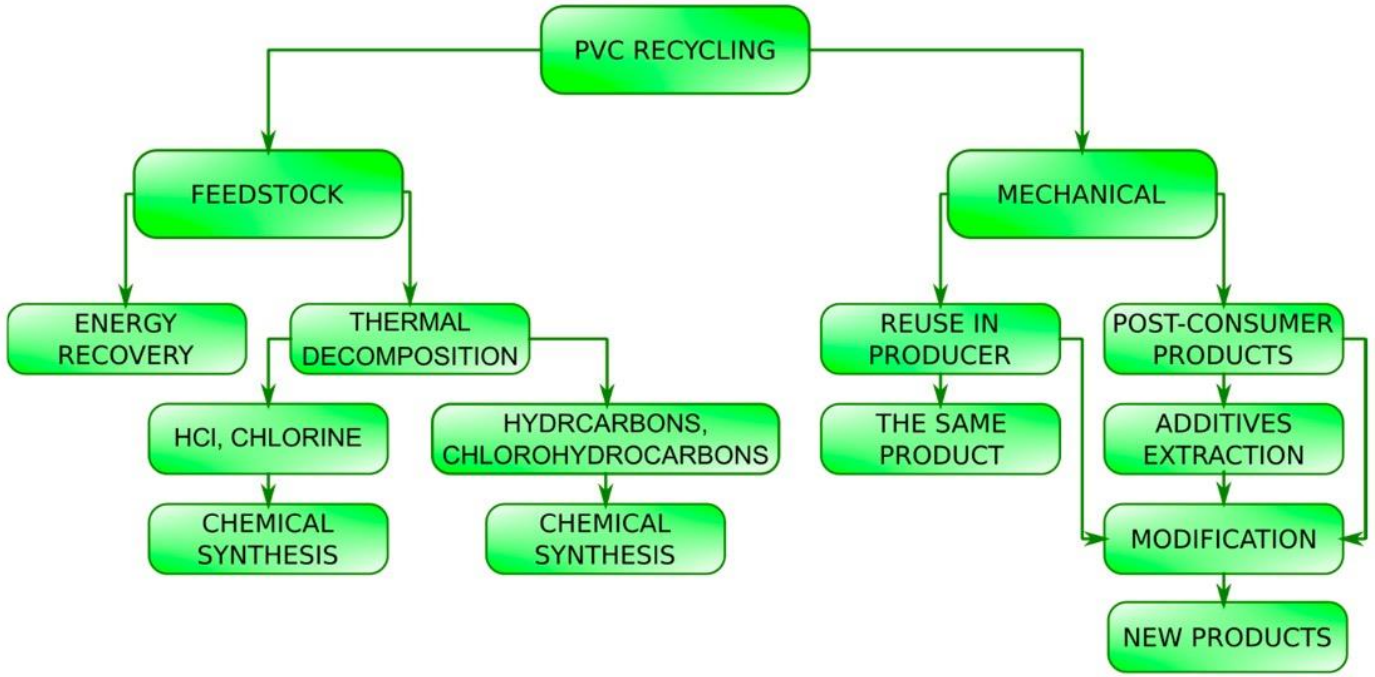

Figure 2. Simplified scheme of poly(vinyl chloride) recycling system.

Polymers **2022**, *14*, 3035.

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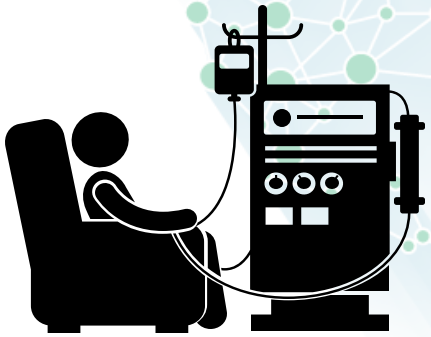
Circular Economy

IS THIS POSSIBLE WITH PVC FROM RRT WASTE?



Nephrol Dial Transplant (2015) 30: 1018–1027
doi: 10.1093/ndt/gfv031
Advance Access publication 24 March 2015

ndt
Nephrology Dialysis Transplantation

Original Articles

Eco-dialysis: the financial and ecological costs of dialysis waste products: is a 'cradle-to-cradle' model feasible for planet-friendly haemodialysis waste management?

Giorgina Barbara Piccoli[1]*, Marta Nazha[2], Martina Ferraresi[1], Federica Neve Vigotti[3], Amina Pereno[4] and Silvia Barbero[4]

Nephrol Dial Transplant. 2015 Jun;30(6):1018-27.

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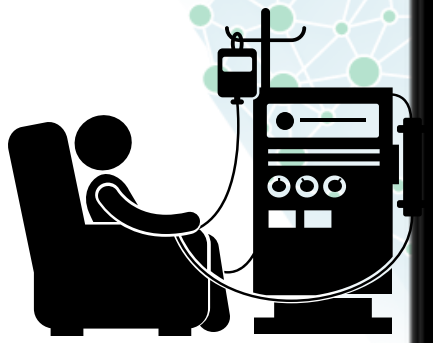

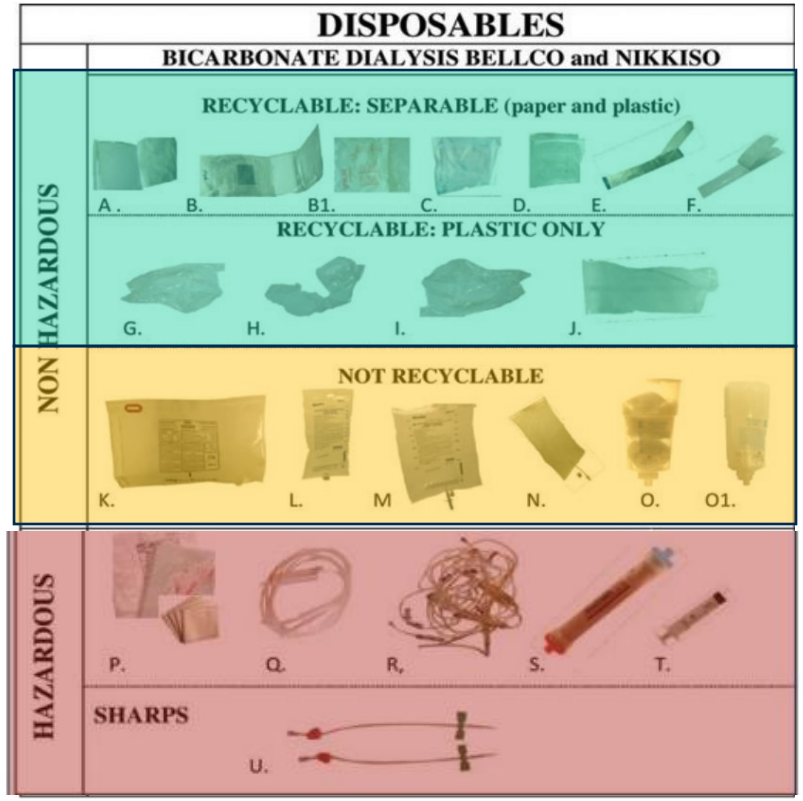

15% of weight

30% of weight

55% of weight

Nephrol Dial Transplant. 2015 Jun;30(6):1018-27.

MacBook Pro

KI REPORTS
KIReports.org

RESEARCH LETTER

Quantification of Recyclable Peritoneal Dialysis Plastics in a Home Dialysis Program–An Opportunity for Resource Stewardship

Nisha Rao[1], Tasleem Rajan[1] and Caroline Stigant[1]

[1]Division of Nephrology, University of British Columbia, Vancouver, British Columbia, Canada

Correspondence: Caroline Stigant, Division of Nephrology, 1990 Fort Street Suite 201 Victoria The University of British Columbia Faculty of Medicine Vancouver V8R 6V4, British Columbia Canada. E-mail: caroline.stigant@islandhealth.ca

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Kidney Int Rep (2023) **8,** 365–367; https://doi.org/10.1016/j.ekir.2022.11.018
KEYWORDS: peritoneal dialysis; greenhouse gas emissions; recycling; climate change; sustainable kidney care

INTRODUCTION

Climate change is the greatest threat to human health. An estimated 4.6% of global annual greenhouse gas emissions arise from health care.[1] Rising temperatures and heat stress can cause dehydra-

Table S1. PD therapy of an average continuous ambulatory PD patient performing 4 exchanges generated 58.76 g and 222.88 g of recyclable PP and PVC plastic, respectively per day. Automated PD therapy (4 exchanges at night with a day fill) generated 74.49 g of PP recyclable plastic with the Home Choice machine

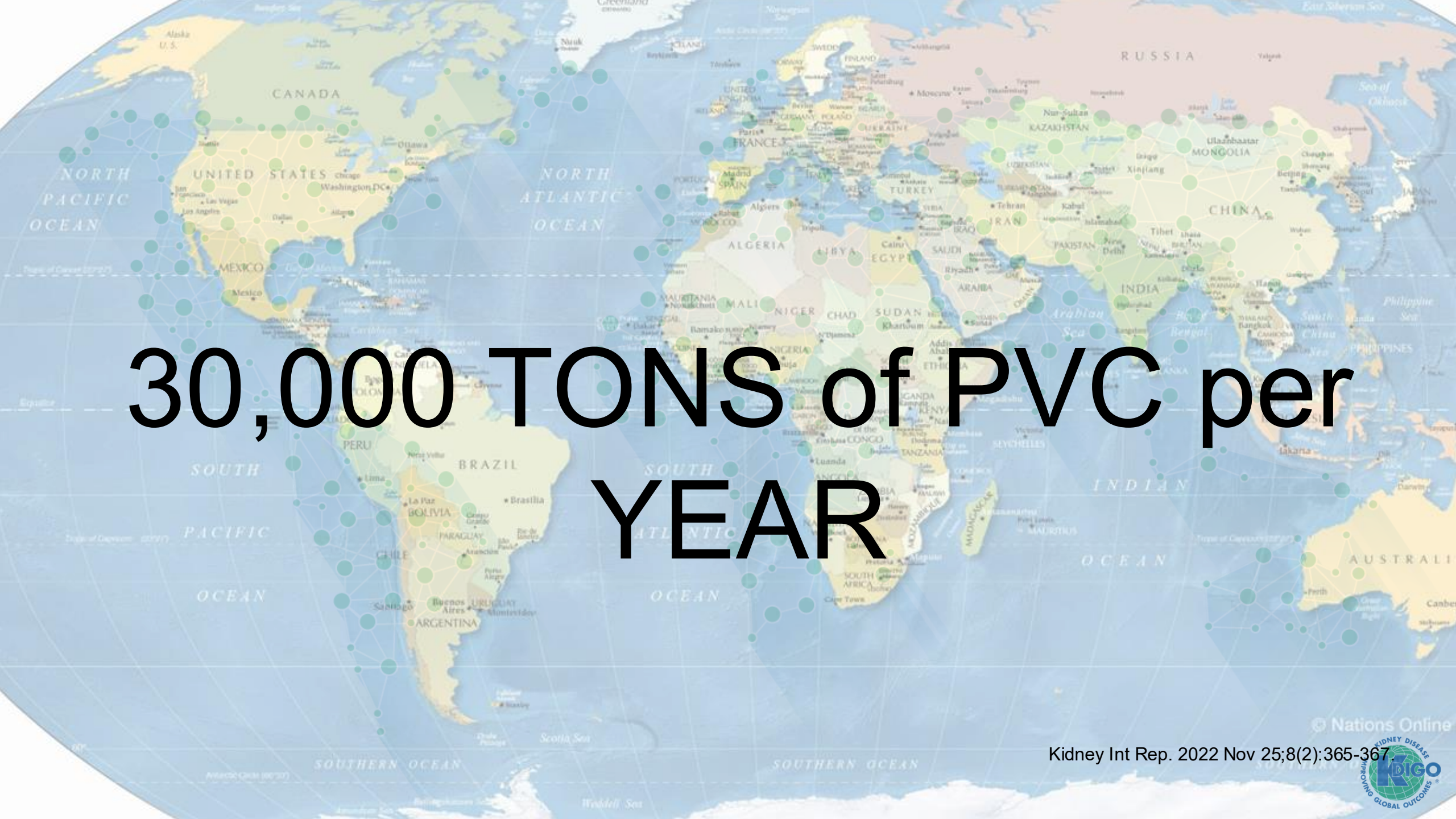
Table 1. Weight of PP and PVC per patient per year

	CAPD		APD			
	PP	PVC	PP		PVC	
			PD modality		PD modality	
			Home choice	AMIA	Home choice	AMIA
Per d (grams)	58.76	222.88	74.49	88.57	272.48	323.4
Per yr (Kg)	21.45	81.35	27.19	32.33	99.46	118.04
Carbon emissions saved by recycling vs. landfill per patient per year	0.02	0.08	0.02	0.03	0.10	0.12

APD, automated peritoneal dialysis; CAPD, continuous ambulatory peritoneal dialysis; PD, peritoneal dialysis; PP, polypropylene; PVC, polyvinyl chloride

100 KG OF PVC

Kidney Int Rep. 2022 Nov 25;8(2):365-367.



Kidney Int Rep. 2022 Nov 25;8(2):365-367.

Vinyl Council

100 Tons/year

Vinilo en Movimiento

40 Tons/year

Biotrash

15 Tons/year

https://www.baxter.com/sites/g/files/ebysai3896/files/202306/2022_Baxter_Corporate_Responsibility_Report

We Invited all Patients enrolled in a private APD program to return to the clinic with APD waste.

Waste was gathered

Weighted

Transported

Washing APD plastic waste in 0.5% chlorine solution

12 patients (60%)

16.6 kg/month (58% PVC)

116 kg

CAN THIS BE FINANCIALLY SUSTAINABLE?

Table 1. Cost analysis

Costs[a,b]	Mexican pesos	US dollars[c]
Fixed assets		
Mill[d] (Custom made Mill10 HP, 7.4 kWh engine)	145,000	8529
Dryer[d] (Custom made 35 kWh energy consumption)	180,000	10,588
Processing device[d] (not yet purchased 75 kWh 150 kg/h capacity)	150,000	8823
Van	315,900	18,582
Total	790,900	46,522
Monthly costs to recover initial investment in 5 yr	13,182	775
Monthly costs for recycling PVC from 345 patients on APD per month		
Wages per worker (considering 2 workers)[e]	8589 (17,178)	505 (1010)
Rent	15,000	882
Electricity (3500 KW/h)	10,000	588
Water (5000 l) (1.5 l/kg PVC obtained)	1000	59
Gasoline[f] (90 l)[c] (250 km/wk)	2000	118
Miscellaneous supplies (bags, spare parts)	2000	118
Monthly costs to recover expenses in 5 yr	13,182	775
Total	60,360	3550

Just INVOLVING **5%** of APD patients in Mexico City would make it possible!

1. STORAGE AND TRANSPORTATION OF PVC
2. SEPARATION CAN BE LABOR INTENSIVE
3. PVC IS CHEAP… THE NEED FOR LARGE AMOUNTS TO BE SUSTAINABLE


QNB
JAMA
DOHA2019
ITALIA
QNB
DOLORUNSO
QNB
DOHA2019
QNB
KLEIN
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BOL
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IAAF World Athletics Champions
DOHA2019
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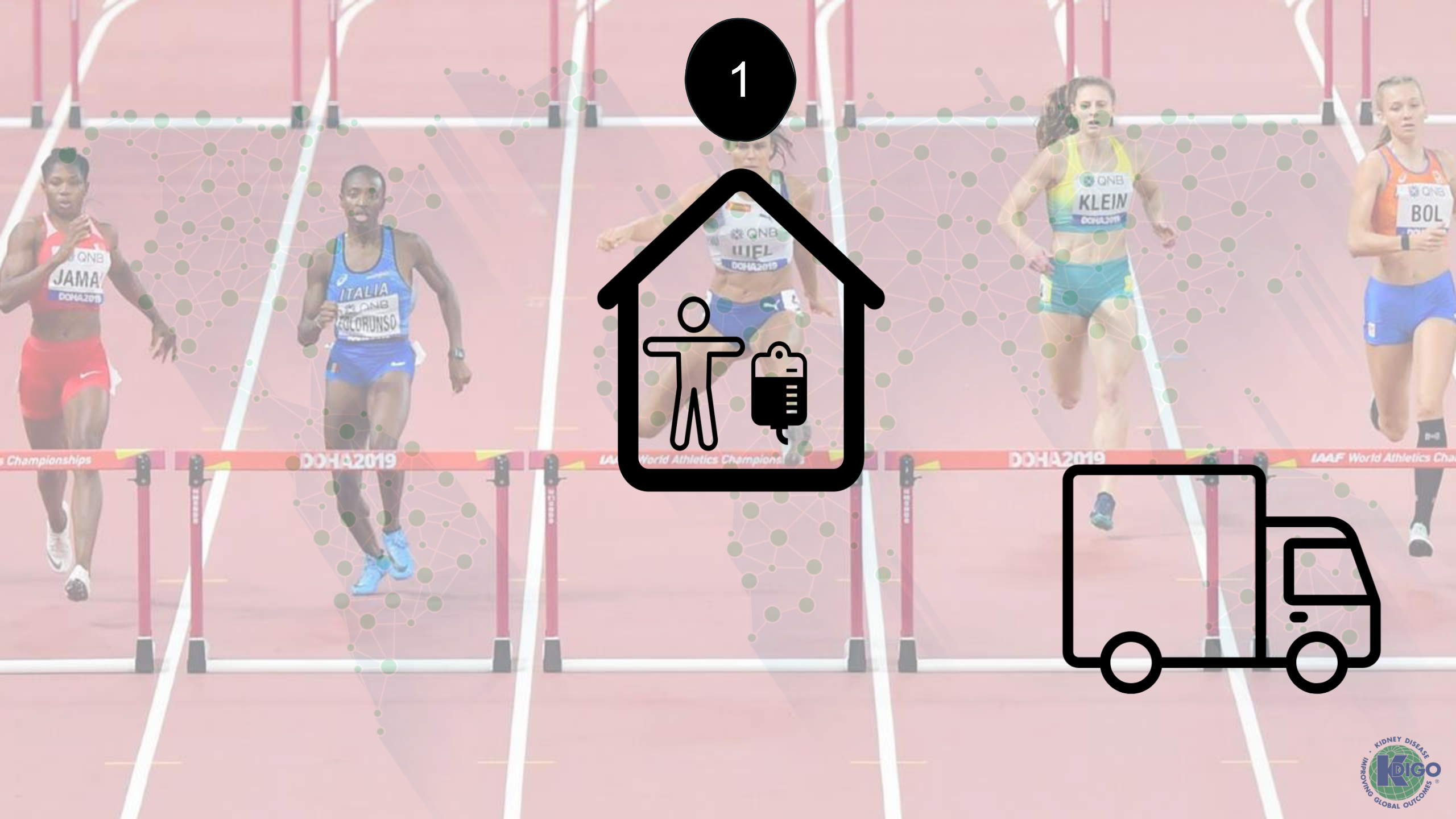
1
APD MATERIAL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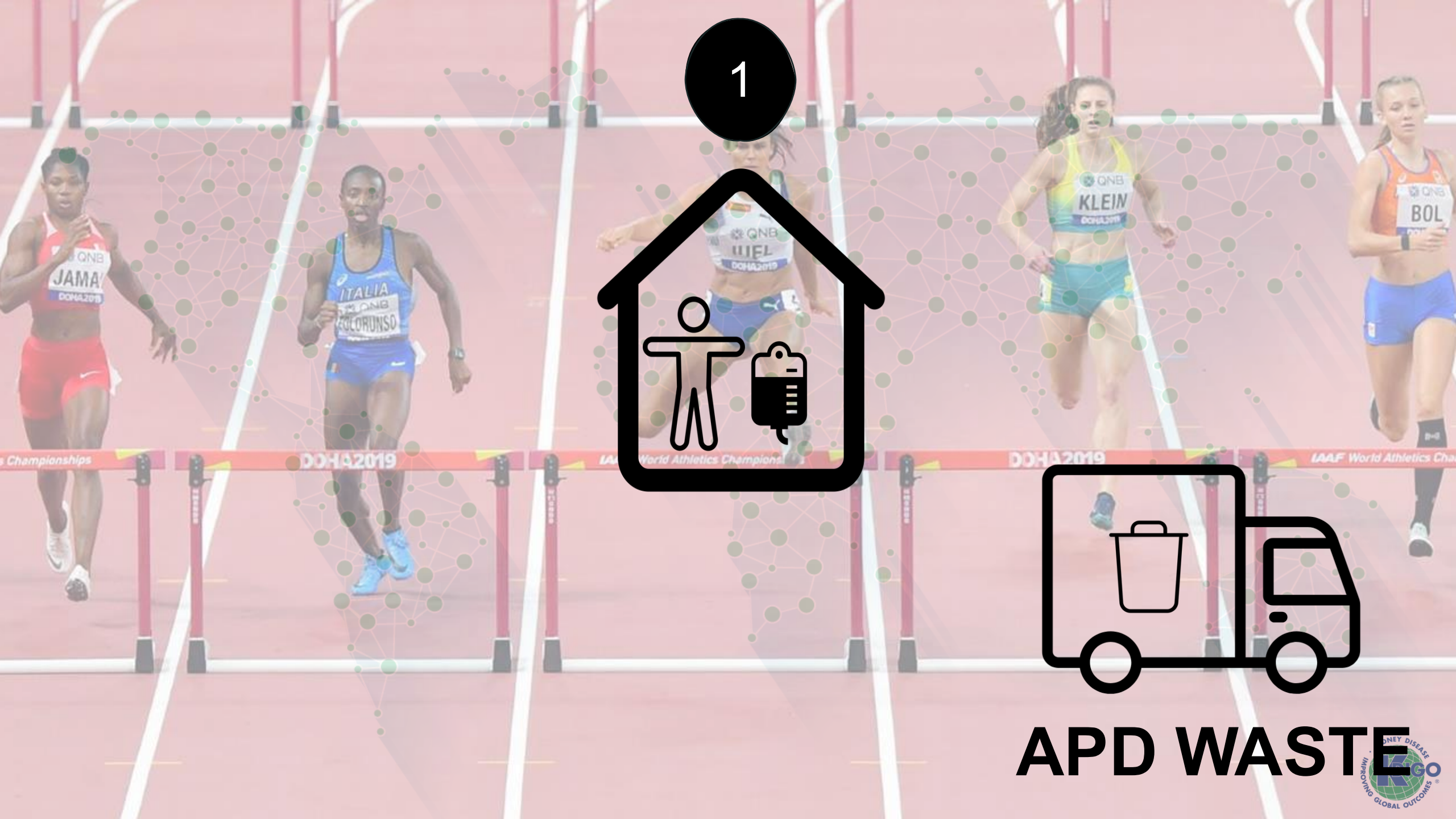
KLEIN
BOL
DOHA2019


1
APD MATERIAL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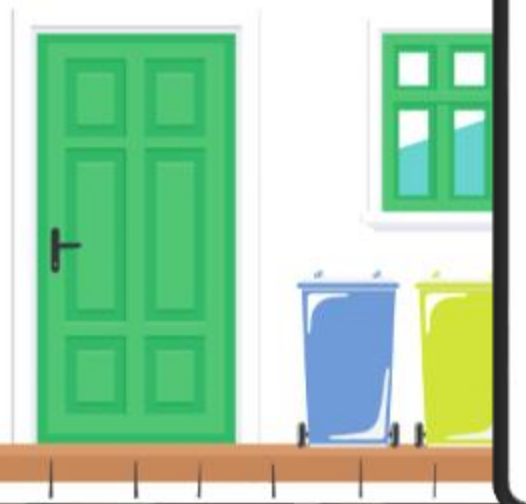
APD WASTE

A HEALTHIER TOMORROW
BAXTER SUSTAINABILITY

PD RECYCLING AT HOME



FREQUENTLY ASKED QU

WHO CAN RECYCLE?

Any patient who lives in a metropolitan area and has their therapy items dropped off by a Baxter delivery driver is eligible for the program. Not sure if you are eligible? Call HomeCare on AUS 1800 229 837 or NZ 0800 466 322

WILL RECYCLIN COST ME ANYT

No. The program costs are paid f
After you sign up for the progra
give you 2 small recycling bins a
next PD delivery.

WHAT DOES BAXTER PICK UP?

Our Baxter delivery drivers will collect the plastic you recycle from the 2 bins, as well as folded cardboard boxes.

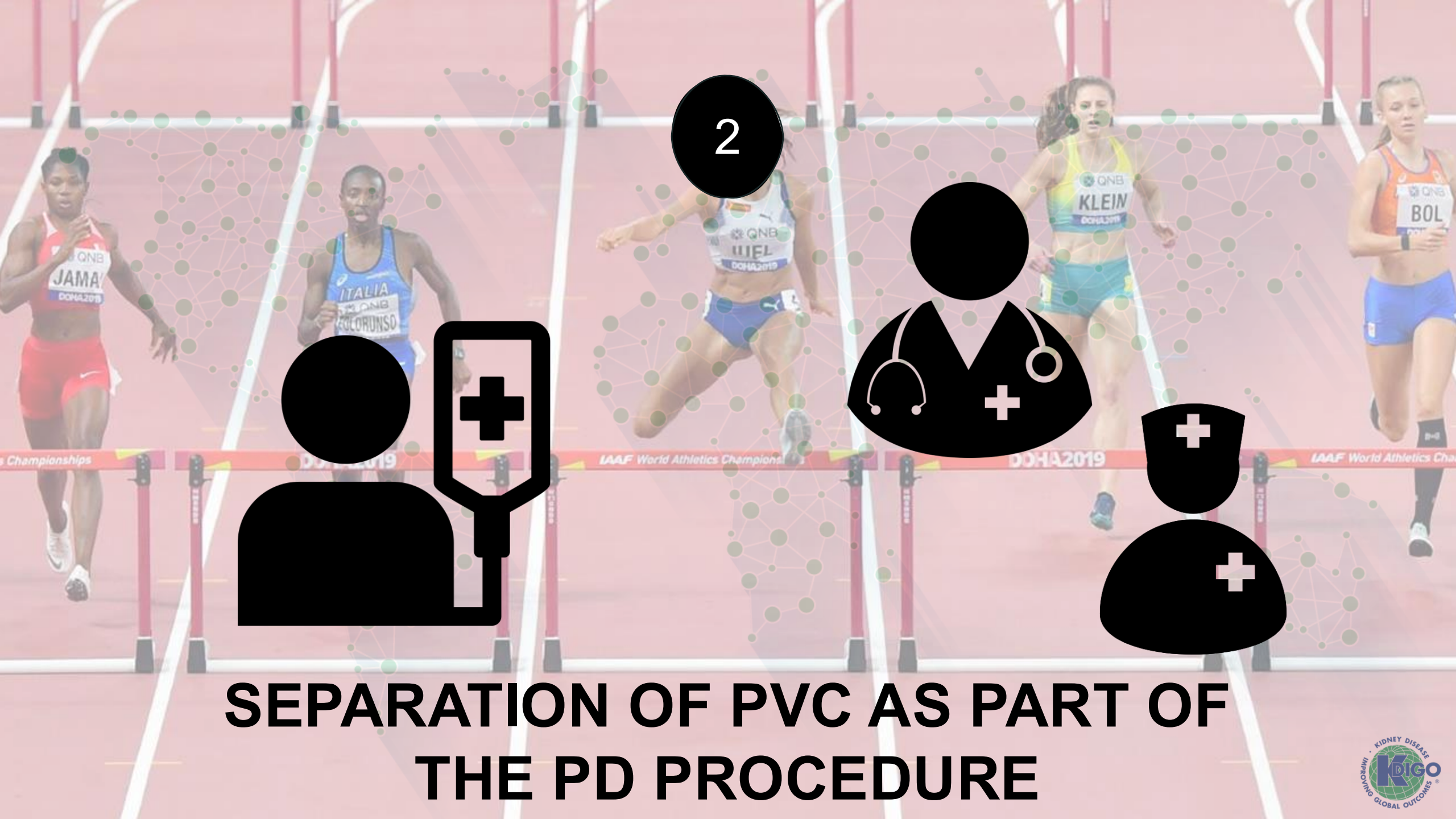
DRIVER RESPONSIBILITY

During the monthly inventory delivery, the driver will perform the following duties:

- Remove all flattened and stacked Baxter cartons.
- Remove bin liners, including the contents of each bin.
- Replace bin liners.

The delivery driver will conduct a visual inspection of the bin contents to ensure only suitable items are in the bins. If the bin contains unsuitable items, the driver will request that you dispose of the contents with your general household waste. The driver will be able to answer any questions you may have about which items are suitable for recycling.

KIDNEY DISEASE IMPROVING GLOBAL OUTCOMES
KDIGO

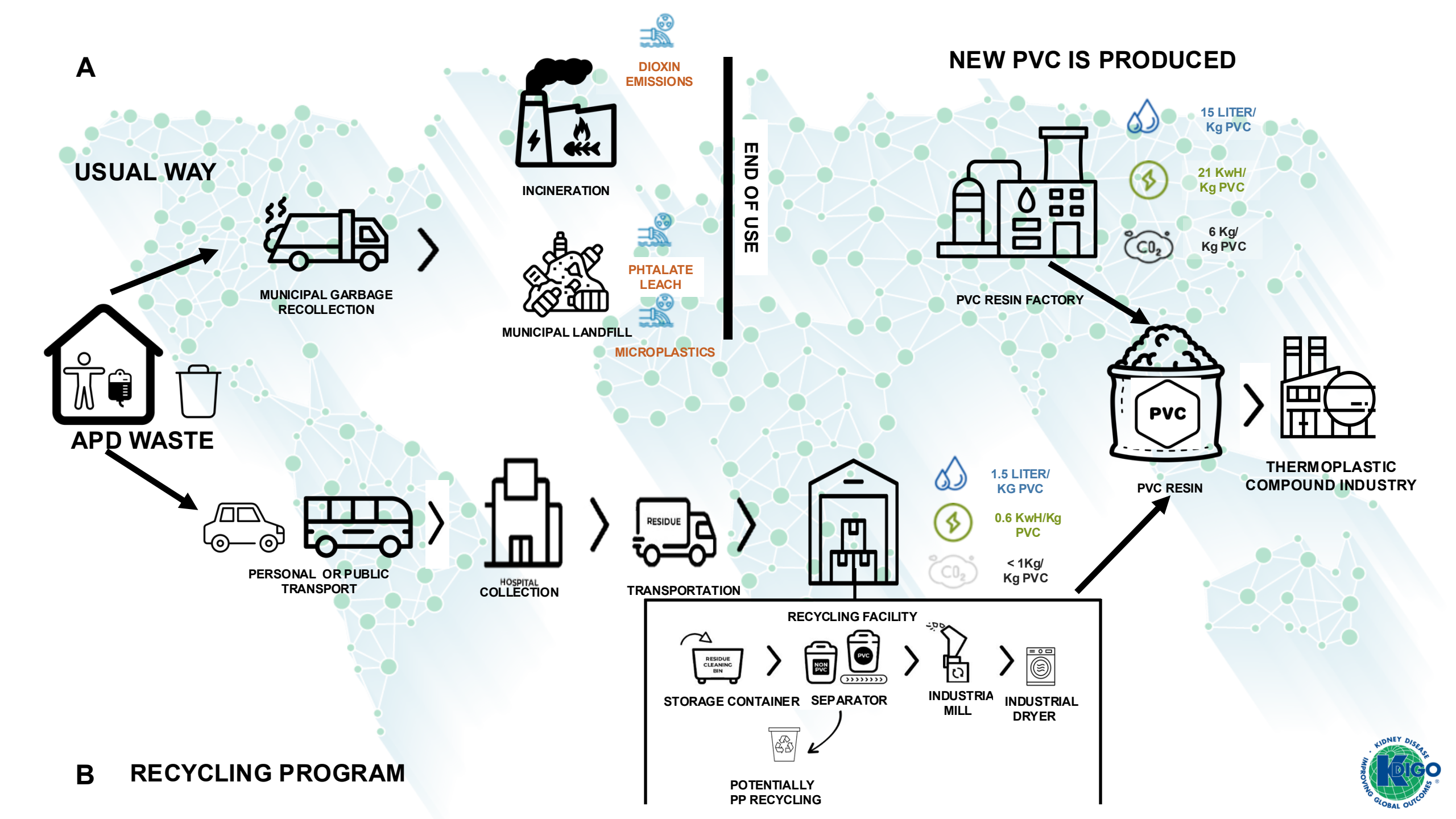


SEPARATION OF PVC AS PART OF THE PD PROCEDURE

3

RECYCLED PVC CAN HAVE ADDED VALUE.

WHAT IS THE ENVIRONMENTAL BALANCE?


A
USUAL WAY
APD WASTE
MUNICIPAL GARBAGE RECOLLECTION
INCINERATION
DIOXIN EMISSIONS
MUNICIPAL LANDFILL
PHTALATE LEACH
MICROPLASTICS
END OF USE
PERSONAL OR PUBLIC TRANSPORT
HOSPITAL COLLECTION
RESIDUE
TRANSPORTATION
NEW PVC IS PRODUCED
15 LITER/ Kg PVC
21 KwH/ Kg PVC
6 Kg/ Kg PVC
PVC RESIN FACTORY
PVC
PVC RESIN
THERMOPLASTIC COMPOUND INDUSTRY
1.5 LITER/ KG PVC
0.6 KwH/Kg PVC
< 1Kg/ Kg PVC
RECYCLING FACILITY
RESIDUE CLEANING BIN
NON PVC
PVC
STORAGE CONTAINER
SEPARATOR
INDUSTRIA MILL
INDUSTRIAL DRYER
POTENTIALLY PP RECYCLING
B RECYCLING PROGRAM

13 L/Kg PVC

21 KwH/ Kg PVC

5 Kg/Kg PVC

PHTALATE LEACH

DIOXIN EMISSIONS

MICROPLASTICS


ARTICLE IN PRESS
KI REPORTS
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RESEARCH LETTER
Combining Patient Care and Environmental Protection: A Pilot Program Recycling Polyvinyl Chloride From Automated Peritoneal Dialysis Waste
Nathan Berman-Parks[1,2], Ilana Berman-Parks[2], Ismael A. Gómez-Ruíz[3], Juan M. Ardavin-Ituarte[3] and Giorgina B. Piccoli[4]
[1]Departamento de Nefrología y Metabolismo Mineral Instituto Nacional de Ciencias Médicas y Nutrición "Salvador Zubirán" (INCMNSZ), Mexico City, Mexico; [2]RE PVC A.C, Mexico City, Mexico; [3]Médica Santa Carmen, Mexico City, Mexico; and [4]Nephrology, Centre Hospitalier Le Mans, Le Mans, France
Correspondence: Giorgina B. Piccoli, Nephrology, Centre Hospitalier Le Mans, 72000 Le Mans, France. E-mail: gbpiccoli@yahoo.it; or Nathan Berman-Parks, Médicas y Nutrición "Salvador Zubirán" (INCMNSZ), Mexico City, Mexico. E-mail: nberman9@gmail.com
Received 26 November 2023; revised 24 February 2024; accepted 4 March 2024
Kidney Int Rep (2024) ■, ■–■; https://doi.org/10.1016/j.ekir.2024.03.008
KEYWORDS: green nephrology; peritoneal dialysis; recycling; sustainability; waste management
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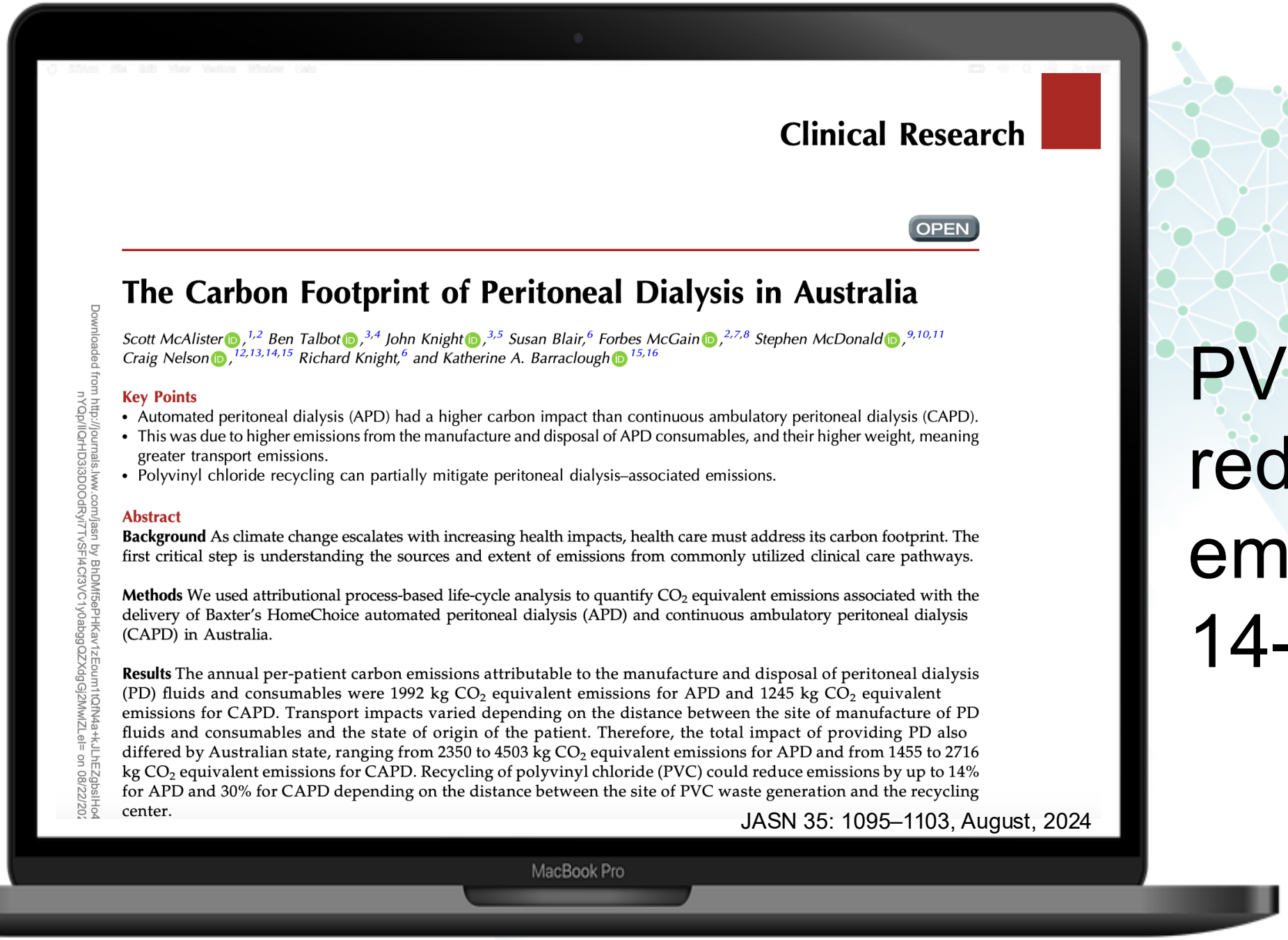


PVC Recycling reduces CO2 eq emissions by 14-30%

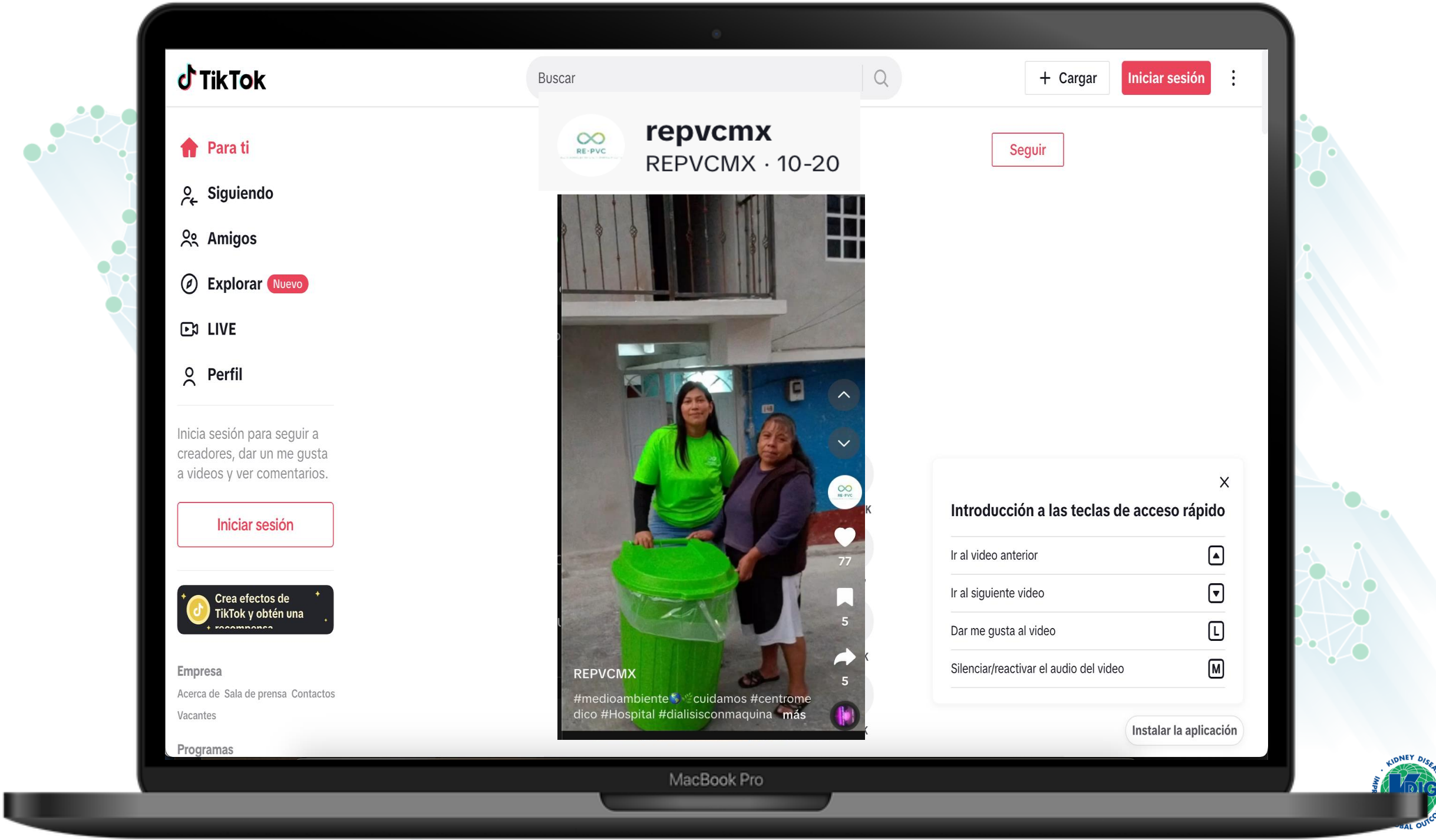
DOES THIS BENEFIT THE PATIENTS?

Disposing of medical waste at home is a burden…

Unmet need for repurposing or the disposal of unused PD supplies

RE·PVC

DEL CUIDADO DE LA GENTE AL CUIDADO DEL AMBIENTE


TikTok
Buscar
+ Cargar
Iniciar sesión
Para ti
Siguiendo
Amigos
Explorar Nuevo
LIVE
Perfil
Inicia sesión para seguir a creadores, dar un me gusta a videos y ver comentarios.
Iniciar sesión
Crea efectos de TikTok y obtén una
Empresa
Acerca de Sala de prensa Contactos
Vacantes
Programas
repvcmx
REPVCMX · 10-20
Seguir
77
5
5
REPVCMX
#medioambiente🌎🌿cuidamos #centrome
dico #Hospital #dialisisconmaquina más
Introducción a las teclas de acceso rápido
Ir al video anterior
Ir al siguiente video
Dar me gusta al video
Silenciar/reactivar el audio del video
Instalar la aplicación
MacBook Pro

RE·PVC

DEL CUIDADO DE LA GENTE AL CUIDADO DEL AMBIENTE

150 Patients

2 Tons/Month

Towards a Sustainable Future

Establishing a recycling program for PVC derived from APD waste is feasible

Environmentally and Financially Sustainable

Industry collaboration can play a valuable role

Active engagement with patients and PD providers is essential for success