

Project Title

A New Life for PVC Waste

Project Lead and Members

Project lead: Dr Andrea Yap

Project members: Gerald Ho; Huang Huijun; Caitlin Ng; Julia Ngaw; Yeo Shu Ming;
Katherine Leong; Cing Khan Lian; Eng Foong Lan; Tong Chin Fern; Hu Xiaoling;
Charmaine Ng; Alvin Tay; Louis Ong; Colin Chua; Suriati Binte Arshad; Bavithira
Selvakumar

Organisation(s) Involved

National University Hospital

Healthcare Family Group(s) Involved in this Project

Healthcare Administration, Medical, Nursing

Applicable Specialty or Discipline

Anaesthesiology, Operations

Project Period

Start date: Nov 2022

Completed date: May 2023

Aims

To implement an efficient and sustainable recycling system for PVC waste generated in hospitals thereby recycling 10% of PVC waste in NUH within 7 months

Background

See poster attached/ below

Methods

See poster attached/ below

Results

See poster attached/ below

Lessons Learnt

- We faced several setbacks to our project especially at the beginning. There was some resistance on the ground to the project for various reasons. Also, there were often mistakes made in collection and segregation of waste, resulting in the recycling bins being contaminated with items not meant for recycling. Initially, the amount of PVC bags collected was low and it was discouraging for the team. However, it took a constant process of troubleshooting, as well as perpetual efforts to educate and remind all staff on the importance of and the process of recycling, to slowly start seeing more positive response towards the recycling effort, which then culminated in more PVC bags being recycled. We learnt that in trying to initiate change, it takes time and patience to change mindsets and habits. We learnt the importance of persevering even in the face of setback and to continue striving for a goal that we believed in, because it is so crucial that we work towards ameliorating our impact on global climate change.
- We truly appreciated the importance of multi-disciplinary team work in the hospital setting. While the project was initiated by one of the doctors in the anaesthesia department, it could only be rolled out successfully with the contribution of hospital staff from different departments. For example, we needed the input of the operations department for the logistics involved in recycling, nursing administrators and staff to implement the recycling in the wards (which are out of the purview of the anaesthesia department), and each individual staff member to put in the effort to choose to recycle a PVC fluid bag. It is extremely heartening to see people from different walks of life and different fields of work to come together to work towards a common goal. Only then can change be made in the hospital.

Conclusion

See poster attached/ below

Additional Information

Accorded the NUH QIX Award* (Merit) Winner for period Jan-Apr 2023

**Quality Improvement Award for Process eXcellence & Service eXperience*

Project Category

Organisational Leadership

Change Management, Behavioural Change, System Change

Care & Process Redesign

Operation Management, Supply Chain

Keywords

Recycling, Polyvinyl Chloride, Plastic Polymer, Global Warming, Carbon
Dioxide Emissions, Medical Waste Disposal, Incineration,

Name and Email of Project Contact Person(s)

Name: Dr Andrea Yap; Dr Huang Huijun

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Incredible Care QIX Award (Process Excellence)

Project Title no. 12 : A New Life for PVC Waste

Department: Anaesthesia

Period: November 2022 – May 2023

Facilitators/Author: Gerald Ho, Huang Huijun, Caitlin Ng

Sponsors (HODs): Dr Bryan Ng

Team Leader/s: Dr Andrea Yap

Team Members: Gerald Ho (Anaes), Huang Huijun (Anaes), Caitlin Ng (Anaes), Julia Ngaw (ESD), Yeo Shu Ming (ESD), Katherine Leong (ADON), Cing Khan Lian (NC/APN), Eng Foong Lan (NM), Tong Chin Fern (NM), Hu Xiaoling (NM), Charmaine Ng (SN), Alvin Tay (Operations), Louis Ong (Operations), Colin Chua (Operations), Suriati Binte Arshad (Operations), Bavithira Selvakumar (Operations)

A. Define the Problem (PLAN)

- Polyvinyl chloride (PVC) is a plastic polymer used in medical equipment such as intravenous fluid bags, oxygen masks and tubing.
- NUH generates over 20,000kg of PVC waste in one year from the abovementioned items
- Previously, all of this waste was incinerated, which is equivalent to at least 23,700 kgCO₂¹.

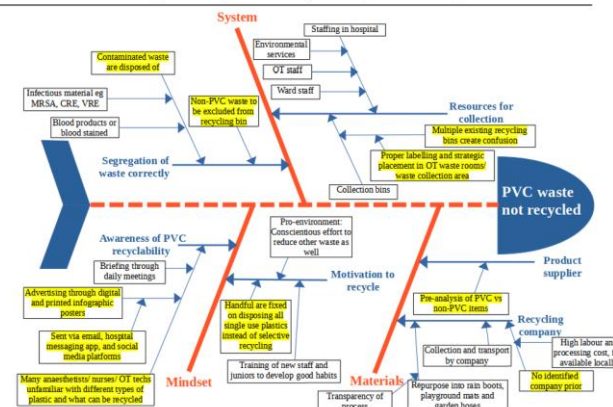
¹ Rizan C et al, Mar 2021. The carbon footprint of waste streams in a UK hospital. Journal of Cleaner Production, Vol 286, 1 March 2021, 125446.

B. Goal (PLAN) Set SMART goals | Specific, Measurable, Achievable, Relevant, Time-based |



- Primary Goal
 - To implement an efficient and sustainable recycling system for PVC waste generated in hospitals
 - Recycle 10% of PVC waste in NUH within 7 months (Nov 2022 – May 2023)
 - This is in line with NUH's aim to reduce waste by 25% by 2025.
- Secondary Goals
 - Develop a partnership with a recycling company specialising in PVC recycling
 - Increase awareness and engagement among staff on the importance of PVC recycling
 - Monitor and evaluate the effectiveness of the recycling program to ensure continuous improvement

C. Problem Analysis (PLAN) Gap Analysis

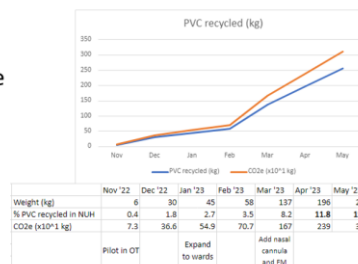


D. Interventions & Action Plan (DO)

SN	Description	People responsible	Date of Implementation
1	Source for dedicated partners/ facilities for recycling (PDSA 1) 1. Partnering with Lian Gim (S) Trading for collection and recycling of PVC fluid bags 2. Assessment by Lian Gim for other PVC products to recycle 3. Site visit for transparency of process	Dr Andrea Yap Environmental Services Department (ESD)	1. 28th Oct 2022 2. 15th Dec 2022 3. 13th Mar 2023
2	Correcting mindsets and misconceptions (PDSA 2) 1. Regular broadcasting of project and PVC recycling awareness through media platforms 2. Infographic posters in OT, department, and wards 3. National media coverage (newspaper article from various outlets) 4. Survey for feedback and PVC recycling fact sheet 5. Department newsletter	Dr Andrea Yap, Huang Huijun, Gerald Ho, Caitlin Ng	1. Nov 2022 - Mar 2023 2. Nov 2022 - Mar 2023 3. 15th Feb 2023 4. 22nd Mar 2023 5. 9th Apr 2023
3	Improve ease of recycling within NUH (PDSA 3) 1. Have dedicated bins for PVC collection, distinguish from other recycling bins, strategic bin location 2. Streamline collection process from OT to collection point 3. Routine surveillance of bins by identified stakeholders 4. Expand to ICU/ wards in NUH 5. Include collection of nasal cannulas and face masks for recycling after receiving "green light" from Lian Gim 6. Expand to AH and NTFGH	Dr Andrea Yap, Huang Huijun, Gerald Ho, Caitlin Ng Ward and OT nursing staff, ESD	1. Nov 2022 2. Nov - Dec 2022 3. Nov - Apr 2023 4. 6th Jan 2023 5. Mar 2023 6. May 2023

E. Benefits / Results (CHECK)

- Exceeded target of 10% hospital-wide monthly recycling rate since Apr 2023, compared to no recycling done prior to Nov 2022
- Total 8875 kgCO₂e saved so far = 46,219 km driven by car



Source: <https://www.sciencedirect.com/science/article/abs/pii/S0959652620354925> - Rizan et al, The carbon footprint of waste streams in a UK hospital.
<https://www.statista.com/statistics/1185559/carbon-footprint-of-travel-per-kilometer-by-mode-of-transport/> - CO₂e of car

F. Strategy for Spreading/ Sustaining (ACT)

Materials	<ul style="list-style-type: none"> Establish a good relationship with the PVC recycling firm for long term collaboration PVC materials are transported to a recycling plant overseas where labour and processing costs are cheaper than Singapore Expansion of scope - other potential items that may also contain PVC and non-PVC plastic material
System	<ul style="list-style-type: none"> Have labelled recycling bins as a permanent fixture in the ward and OT utility rooms Incorporate recycling into the hospital protocols for waste management, involving the doctors, nurses and environmental services staff Expansion of involvement - engage the rest of the NUHS cluster and other hospitals in the future
Mindset	<ul style="list-style-type: none"> Continued education and reminders to all hospital staff through digital and printed infographic posters, social media platforms, and hospital intranet - habit forming Training of new staff who join NUH on recycling processes Involvement of more like-minded and interested individuals from various departments and job scopes to come on board the recycling initiative

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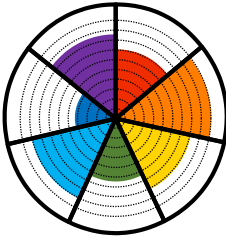
- Carbon dioxide equivalents (CO₂e)
 - Life Cycle Inventory analysis (LCIA) of PVC bags, which looks at the global warming potential (GWP) among other factors, was approximated from a Swedish report on the LCA of blood bags.

PVC item	GWP100 (kg CO ₂ e/ kg)	Disposal (kg CO ₂ e/ kg)
PVC bags	17.890	12.189
Simple face mask	No data available	12.189*
Nasal cannulas	No data available	12.189*

- The disposal (incineration) of a PVC bag contributes to roughly 70% of the total CO₂ emissions from its entire life cycle. Disposal of medical waste in Singapore is primarily through high temperature incineration.
- There is scarcity of data for the LCIA of most medical equipment. Hence, CO₂e generated from the disposal of simple face masks and nasal cannulas will be approximated from the disposal (kg CO₂e/ kg) of PVC bags, since the material is similar.

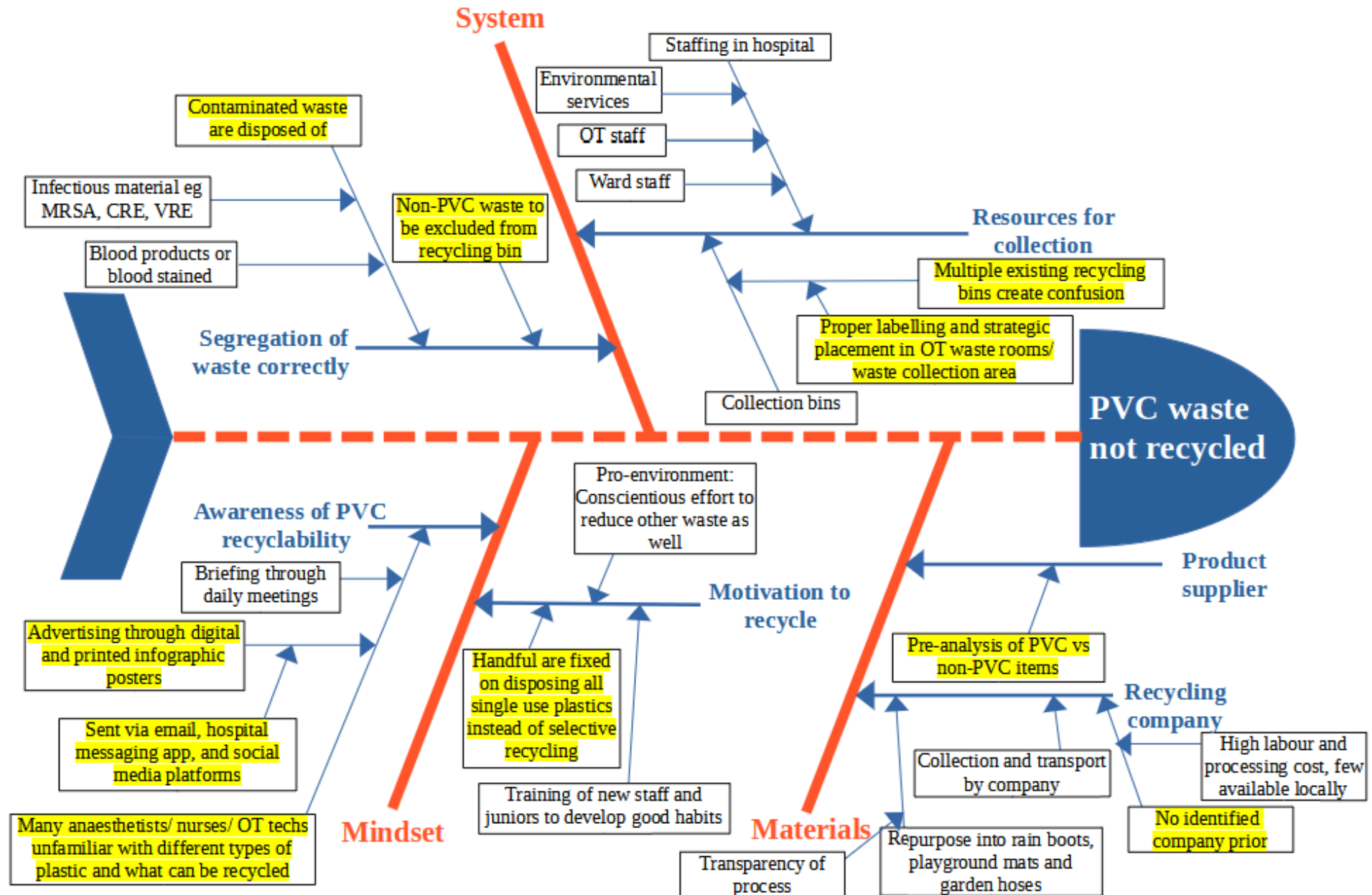
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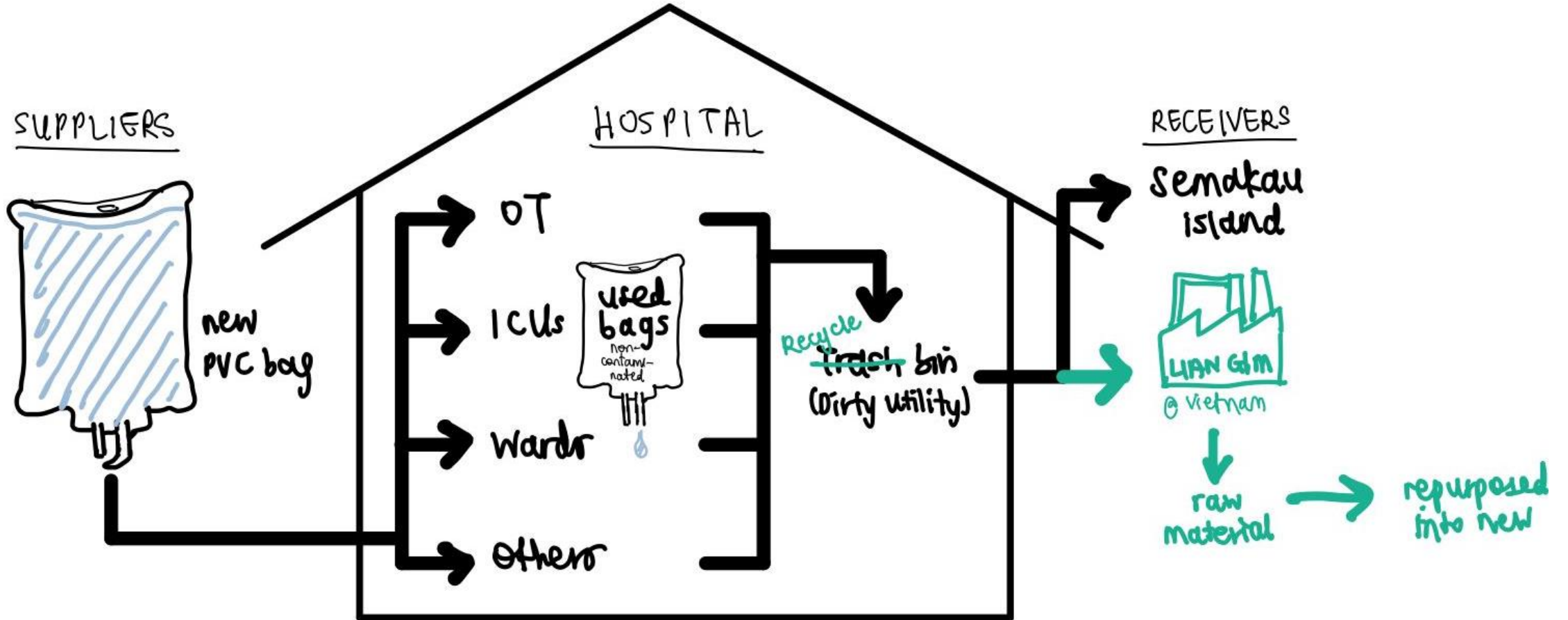


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C. Problem Analysis (PLAN) Value Stream Map

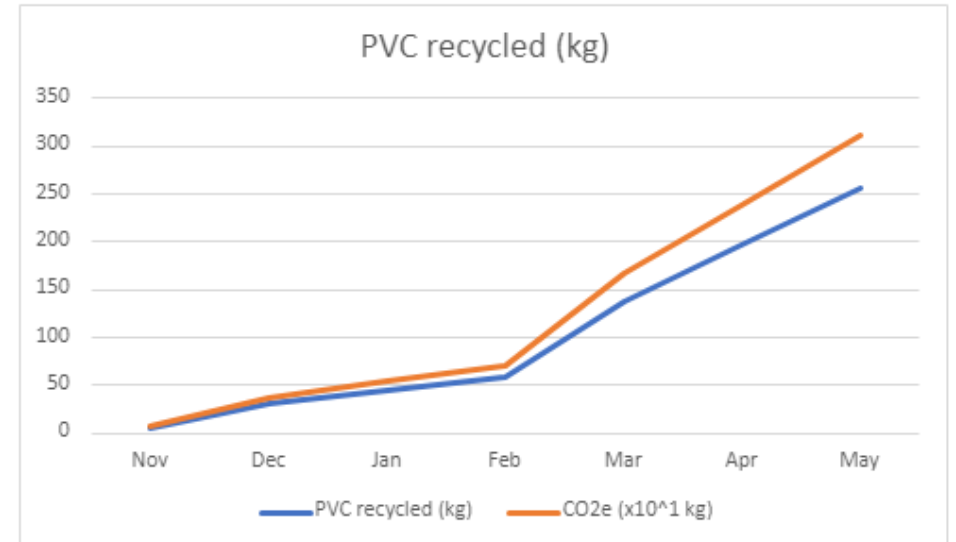


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	Nov '22	Dec '22	Jan '23	Feb '23	Mar '23	Apr '23	May '23
Weight (kg)	6	30	45	58	137	196	256
% PVC recycled in NUH	0.4	1.8	2.7	3.5	8.2	11.8	15.4
CO ₂ e (x10 ¹ kg)	7.3	36.6	54.9	70.7	167	239	312
	Pilot in OT		Expand to wards		Add nasal cannula and FM		

Source

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