

GREEN NEPHROLOGY: REDUCE, RE-USE, RECYCLE IN THE DIALYSIS UNIT CASE STUDIES AND HOW-TO GUIDES

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Background

Healthcare produces vast quantities of waste. In the 12 months from April 2005, the NHS generated over 400 thousand tonnes of waste, of which 29% was clinical waste. This is equivalent to over 5kg of waste per patient per day. The disposal of this waste costs the NHS around £73 million pounds a year. It seems likely that kidney care contributes significantly to the production of this waste. Dialysis remains the most common treatment for end-stage renal disease, and the increase in its availability has been supported by single use, pre-packaged products. These generate a lot of packaging waste and then mainly become clinical waste, limiting the potential for recycling.

A single haemodialysis session produces about 2.5 kg of solid clinical waste, of which 38% is plastic. This amounts to an estimated 390 kg per year per haemodialysis patient, which is likely to increase further with the use of the newer, more portable, machines designed for home use. A patient undertaking a standard peritoneal dialysis regime produces even more - about 617 kg per year. None of these estimates include the significant amounts of packaging waste.

Sustainable waste management policies and recycling programmes are becoming more common, particularly at a trust level. However, the results of the Green Nephrology Renal Unit Survey of Sustainability (available at <http://www.greenerhealthcare.org/nephrology-resources>) found that simple facilities to segregate plastic and packaging waste for recycling are not present in the clinical areas of over 70% of renal units. So it is not surprising that less than one third of renal units in England, Scotland and Wales currently recycle *any* of the plastic and packaging waste that comes from the single-use dialysis equipment. In the small proportion of renal units that do recycle some of this waste, most estimate that they don't recycle very much of it (less than 40%).

The three case studies outlined here are intended to show that the principles most commonly used to underpin waste reduction strategies – reduce, reuse, recycle – can be successfully applied to renal units, and that financial savings can be made. Applying these strategies can be remarkably simple, and the repetitive nature of the dialysis treatments means that the benefits are continually accrued. The final part of this 'How to...' guide describes how to undertake a waste audit, which will allow individual units to identify where best to focus their attention.

REDUCE CASE STUDY

Opportunities to reduce waste when switching to haemodiafiltration



The dialysis unit at the Queen Margaret Hospital, Dunfermline, has 20 stations and provides over 13,000 treatments per year. Mary Thompson, a dialysis nurse in unit, ran a series of Waste Watch Weeks there in 2009, and identified opportunities to improve practice.

The unit has recently moved towards providing online haemodiafiltration (HDF) using 15 Fresenius 5008 machines. Mary noted that, for every dialysis session, a one litre bag of normal saline was used to re-infuse the patient's blood at the end of the treatment. This bag would be opened and attached to a giving set at the start of the treatment (ready for use should the patient suffer a hypotensive episode during their dialysis treatment), despite the fact that the newer haemodiafiltration machines were able to prepare ultrapure sterile substitution fluid directly from the dialysate by directing it through an ultrafilter.

When it came to re-infusing the patients blood at the end of the treatment, only 200 mls of this fluid would typically be required. The remaining 800mls of normal saline, the plastic bag

containing it, and the plastic giving set were then all placed in an orange bag – along with the extracorporeal circuit and bicarbonate bag - and disposed of through the clinical waste stream. Mary realised that there were a number of opportunities to **reduce**...

REDUCTION 1

The use of saline and giving sets was reduced by stopping the unnecessary practice of hanging a bag for emergencies in favour of using the online facilities for emergencies and re-infusion. This saved not only the carbon embodied in their manufacture, but also the emissions associated with their disposal.



A bag of normal saline was costing the dialysis unit £0.52, whilst a single giving set was costing £0.35.

During the course of the 10,764 treatments provided per year, the use of online substitution fluid saves £9,364 (minus the small but less quantifiable cost of producing the exact fluid volumes online) in procurement costs alone (waste disposal savings are outlined below).

REDUCTION 2

The amount of clinical waste was further reduced by improving segregation at source. The first measure had already removed a partially filled bag of normal saline and giving set from the waste stream, but the bicarbonate bag could also be diverted away from the clinical waste stream to domestic waste.

Bicarbonate is added to the dialysate throughout the treatment. Although it is sometimes supplied in plastic containers (see the Recycling Case Study), in Mary's unit the bicarbonate is provided in bags (often referred to as B-Bags). Mary realised that these bags could be placed in the domestic waste stream after each treatment (as ongoing efforts to find a facility willing to recycle them have proven unsuccessful).

Cost saving from the more sustainable waste management strategy

These two initiatives had reduced the clinical waste from a single treatment by 2 kg through the removal of one bag of reperfusion saline (usually with 800 mls remaining in it), one giving set and the bicarbonate bag. Over the annual 10,764 treatments provided by the unit using Fresenius 5008 machines, this would result in a reduction in clinical waste of 21,528 kg – or 21.5 tonnes. As a relatively large producer of clinical waste, the Queen Mary Hospital was

charged at £300 per tonne of clinical waste, leading to an annual saving of £6458.40. This saving was offset by the increased cost of the domestic waste (£85 per tonne) attributable to the addition of the bicarbonate bag to this waste stream. The annual 10,764 treatments produce 10,764 bicarbonate bags, with a total weight of 10.764 tonnes and a disposal cost of £914.90, resulting in an overall annual saving of £5543.10.

Summary

The Queen Margaret Unit also provides some treatments using Fresenius 4008 machines; although online substitution fluid cannot be made in the same way with these, further savings were made by switching to smaller bags of saline for the reperfusion process, and by again removing the B-Bags from the clinical waste.

In order to ensure patient safety was maintained during these changes, Mary organised educational sessions for staff about the use of online substitution fluid for hypotensive patients, and produced local guidance suggesting that all newly established HD/HDF patients are to have a 500ml bag of normal saline set up until they were considered to be stable during their sessions, and that a single 500 ml bag of normal saline is set up on an individual mobile drip stand with the giving set connected (for use in emergencies).

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REUSE CASE STUDY

Second Lives for Dialysis Packaging & Equipment

Concerns regarding the infection risks of reusing equipment, which are often exceedingly small, have led to the adoption of precautionary principles, with the result that single use, disposable items of medical equipment have become ubiquitous throughout healthcare settings. This is particularly true in dialysis units. For example, it is not uncommon for patients to require slightly more than the contents of a single six litre acid cartridge during a haemodialysis session. In such circumstances, only a small amount of the contents of the second cartridge is required, but it is not considered safe practice to re-use the remainder of the contents for the next patient, and it is therefore wastefully discarded. Until risk management strategies within

infection control policies become more sympathetic towards the health threats posed by environmental issues, opportunities for the reuse of medical equipment are likely to remain limited.

However, the reuse of many items found within renal units becomes possible with only a little re-organisation. For example, plastic sharps carriers for cannulation can be washed and re-used and should be chosen in preference to paper trays, whilst plastic sharps containers can be washed and reused if they can be safely emptied into a central collection point. Many suppliers are able to collect and directly re-use the pallets and cardboard boxes used in the delivery of dialysis supplies.

Patients have been particularly inventive in finding second lives for their equipment and packaging and many patients recommend the use of the internet resource, Freecycle (www.uk.freecycle.org), to pass on cardboard boxes to others.



RECYCLING CASE STUDY

The Use of Baling Machines to Compact Waste from Dialysis Units

In 2005, an assessment by the waste management team responsible for the Birmingham Heartlands Hospital satellite dialysis unit at Runcorn Road identified two separate, but not uncommon, issues. The first issue was the disposal of the plastic acid and bicarbonate cartridges which were needlessly entering the clinical waste stream and therefore being incinerated, an expensive and environmentally damaging route of disposal. The second issue

was the disposal of the very large amounts of cardboard packaging associated with the clinical supplies purchased by the unit. Despite its recyclable nature, this was entering the domestic waste stream. Moreover, collections were infrequent and the cardboard was frequently accumulating in piles. As well as taking up valuable space within the unit, the identification of the fire risk that this posed had prompted the facility's leaseholder to cover the resulting increases in insurance costs by requesting a higher rental fee. The solution to all of these problems was the purchase of a baling machine to compact the waste.



The machine (picture 1) is housed in the storage room adjacent to the main dialysis unit and measures approximately 6ft by 3ft by 3ft. An electronic machine was chosen ahead of piston-driven alternatives as it makes very little noise, an important consideration given the close proximity to a clinical area.

At the end of a patient's dialysis session the acid cartridge is emptied and rinsed with tap water by the nurse. The cartridges are collected in plastic bags holding eight cartridges each (picture 2). These bags are then baled together, along with bags containing other plastic waste collected within the unit (see below and picture 3). Ten bags are baled at a time, with cardboard layers at the top and bottom, to produce packages that weigh approximately 19 kg and are held together with binding tape (picture 4). Packages of this size can be easily moved with the aid of a roller fork. Excess cardboard is baled together in separate packages weighing around 10kg. These plastic and cardboard packages are collected from the unit on a weekly basis, free of charge, by a local company which recycles them. A similar set up is also in place at a second satellite dialysis unit in Castle Vale.

Other plastic items that are collected and baled include shrink wrap, containers for alcohol-based hand gels, bicarbonate cartridges (although this is increasingly sourced in bags), and the containers for bleach and Citrosteril. Particular care must be taken with the containers of substances subject to COSHH regulations (the control of substances that are hazardous to health, such as disinfectants like bleach and Citrosteril), and dialysis units should ensure that they have the necessary sewer discharge consent if these substances are to enter the water course undiluted.

Benefits

The clear **environmental benefits** resulting from the diversion of waste to the recycling stream offer an opportunity for Trusts to highlight their **good corporate citizenship**. The initiative also **frees up the physical space** taken up by accumulating waste and, in the case described here, **reduced a potential fire risk**. Importantly, there are also considerable **financial gains** to be made.

Investment Appraisal

The return on investment will depend on the investment and running costs (resulting from the purchase, installation and maintenance) and the savings resulting from the diversion of waste into cheaper disposal pathways.

A typical dialysis unit will use one acid cartridge per patient. Although the Runcorn Road Satellite Dialysis Unit is a 26 station unit, it is currently run at such a capacity that it generates 270 empty acid cartridges per week, each weighing 300 grams. This equates to 14040 cartridges per year, or 4.2 tonnes of plastic. The cost of disposing of clinical waste is determined by an economy of scale; larger units will produce greater amounts of clinical waste, and will be in a position to negotiate lower disposal costs per tonne. For the purposes of this case study, we have used a cost of £750 per tonne, which is considered representative of the current cost for most satellite units. The cost of sending 4.2 tonnes of plastic to clinical waste is therefore around £3150 per year.

The Runcorn Road unit also produces approximately 1 tonne of cardboard per year. These cardboard boxes were previously being put into domestic waste bins, usually uncrushed, along with other waste. The cost to the unit of their disposal was determined by the number of bins collected per year, which in turn would be influenced by how well crushed the boxes were. It is therefore difficult to provide a method to calculate the savings made, but the waste management team at the Runcorn Road Unit estimate that the introduction of the baler, which

removed the cardboard from this waste stream, has reduced the number of bin collections by 50% and has saved the unit approximately £1000 per year.

Using these figures, the annual saving (equivalent to the overall cost of the original waste disposal methods) is approximately £4000 at the Runcorn Road Satellite Dialysis Unit.

The purchase of a baler requires an initial one-off investment. This is likely to be in the region of £3500 and will include installation. The ongoing costs might be anticipated to include an annual service (for which the Runcorn Road Satellite Dialysis Unit pays £195), the cost of the binding tape (£342 for the 12 reels required by the Runcorn Road Satellite Unit per year), and the cost of the plastic bags (which is likely to be very small and has been assigned a nominal figure of £50 for this case study). Therefore the total cost incurred during the year of implementation is £4087, with an annual cost of £587 thereafter.

The Runcorn Road unit therefore recouped the outlay cost at one year, and has been saving around £4000 thereafter. A comparable saving is also being made at the Castle Vale satellite unit. The savings might be even greater in units using plastic bicarbonate containers.

The Return on Investment

Point in Time	Total investment made to date	Total savings made to date	Return on Investment
End of Year 1	£4,087 ¹	£4,150 ³	102% ⁴
End of Year 2	£4,674 ²	£8,250	177%
End of Year 3	£5,261	£12,400	236%
End of Year 4	£5,848	£16,550	283%
End of Year 5	£6,435	£20,700	322%

¹ Derived from the cost of the baling machine (£3500) and the annual investment (£587) in consumables and maintenance

² Derived from the initial investment (£4087) and the annual investment (£587)

³ Derived from the disposal cost of plastic to clinical waste (£3150) and cardboard to domestic waste (£1000)

⁴ Calculated as (Savings to date / Investment to date) * 100

Maintenance

Regular maintenance is essential if the anticipated life-span of a baling machine (around 10-15 years) is to be achieved. The machine in this case study is serviced on an annual basis. A maintenance contact with the vending organisation is preferable. A provisional plan for waste disposal in the event of a breakdown is also advisable.

Staff Training and Health & Safety Considerations

Cartridges are emptied and rinsed by the nurses at the end of a patient's dialysis session. Operation of the baling machine itself is very simple and only minimal training is required. Initial staff training was provided by the company from whom the baling machine was purchased, but staff joining the unit now receive their training from the unit's Store Manager. When baling the cartridges, staff are encouraged to wear gloves and aprons in case of any spillage. Staff are advised against baling packages greater than 20 kg, and packages are always moved using a wheeled fork.

Potential Barriers to Implementation

A suitable space must be found to house the baling machine. This need not necessarily be indoors as a simple shelter could be built in order to keep the electric parts dry. However, if the machine is outdoors or not close by, staff may be less inclined to bale the waste regularly during wet or cold weather, leading to problems with accumulation.

The attitudes of the staff members are crucial to the success of this initiative. Education around the environmental and financial benefits is likely to improve willingness to bale the waste regularly. Consideration should also be given to the amount of staff time required to operate the machine. At the Runcorn Road Unit the baling machine is typically in use for 20-30 minutes per day, during which time it is operated by a single staff member.

Major Risks

There are no major risks associated with the implementation of a baler to compact dialysis waste. Minor risks can be minimised through appropriate staff education, and clear Health & Safety, Infection Control and Manual Handling guidance. Financial risks can be minimised through the careful development of a business case.

Summary

The introduction of a baler into these dialysis units has led to the redirection of considerable volumes of plastic and cardboard waste into more environmentally friendly waste disposal streams. Significant financial savings have resulted from the reduction of plastic entering the clinical waste stream, and the compaction of the cardboard has reduced the waste storage space required and the fire risk.

How-to Guide: Introducing a baling machine to compact waste from your dialysis unit

- 1. Clarify current practice** regarding the disposal of cardboard and plastic waste within your unit. Consider how the use of a baler might improve it.
- 2. Identify the person(s) in charge of the waste budget** for the renal unit. This is most commonly a member of the Renal Directorate or the Estates (or Hotel Management) Departments. They will be able to provide accurate information regarding the local disposal costs for the relevant waste streams.
- 3. Determine the cost of the baler.** The person in charge of the waste budget may be able to help you identify suitable vendors. Explore maintenance contracts.
- 4. Liaise with the current waste contractor** (almost all Trusts employ the services of private firms to remove and dispose of waste) at an early stage. Identify whether they could process the waste in the form you plan to provide it, and determine any cost that it might entail. Also, explore the possibility of alternative contractors who may remove the waste at a lower cost. In particular, the Environmental Department in your Local Council may know of companies willing to take recyclable material away at no cost.
- 5. Consider the future.** In particular, is a move to central acid delivery planned (thereby dramatically reducing the number of cartridges produced)? Or is expansion of the unit planned, in which case the number of cartridges might be expected to increase?
- 6.** Using the methodology outlined in the case study, **calculate the potential savings** for your unit.
- 7. Identify a suitable location** for the baling machine and any alterations that might be required to house it.
- 8. Explore the idea with the dialysis staff** to ensure that there is sufficient enthusiasm.
- 9.** Use this document to **develop and submit a Business Case.**

GENERAL POINTS ON RECYCLING DIALYSIS CONCENTRATE CONTAINERS

A number of barriers might be encountered by units looking to recycle the plastic dialysate containers. For some waste companies offering recycling, the collection of what are (for them) relatively small and frequent collections may prove financially unviable. Baling the waste at source may solve this problem, as it allows more plastic to be removed with each visit (and also reduces emissions associated with travel). Furthermore, not all waste companies will be able to recycle the containers, and some may wish to run checks to establish that the residual contents of the containers will not damage their machinery. Liaise with your Estates Department – if the

waste company with whom they currently have a contract cannot recycle the containers, then investigate other local options. You may find companies who will be willing to collect the plastic for free, and whilst others may charge for the service it is usually cheaper than sending it to landfill (and definitely cheaper than treating it as clinical waste). The Environmental Department at your Local Council may also help you with this; in Dunfermline, the Local Council has leased four large bins to the renal unit, into which the dialysate containers are placed, and then collects the contents for recycling (as well as other plastic collected in the unit).

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The company from whom the baling machines in this case study were purchased was Landfill Alternatives www.landfillalternatives.co.uk Tel 01295 816733.

The company that picks up the waste from the units in this case study is Alpha Wastecare www.alphawastecare.com

HOW AND WHY TO DO A WASTE AUDIT IN A RENAL UNIT

Waste audits are used to assess the composition of a waste stream. This information is important in order to develop and influence waste management policies and procedures, to assess the extent to which waste is segregated appropriately (identifying opportunities to increase reuse or recycling as forms of disposal), and to monitor the impact of waste minimisation schemes.

Waste audits should be undertaken prior to developing or updating waste management procedures. We also encourage renal units to undertake waste audits at routine intervals to monitor waste segregation and as a tool to raise awareness. Whilst more detailed guidance is available (www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_063274) the process of undertaking a waste audit can be a relatively simple one.

Firstly, consider the intended scope of the audit. Defining the physical space being audited, for example the procedures room or the dialysis unit, will also help to determine what time period is

representative and what waste streams should be considered. Within a renal unit, a waste audit might typically include clinical waste (including sharps) and domestic waste (including kitchen waste, and any separately collected recyclable waste).

Having considered the scope, any specific risks that the audit procedure may entail must be identified, and strategies to mitigate these risks as far as possible should be developed. This is particularly important if manual sorting techniques are to be employed. For example, whilst the gold standard for the analysis of the nature and weight of the contents of sharps containers would be to empty, sort, weigh and subsequently dispose of these contents, the significant risk involved means that this approach is not advisable.

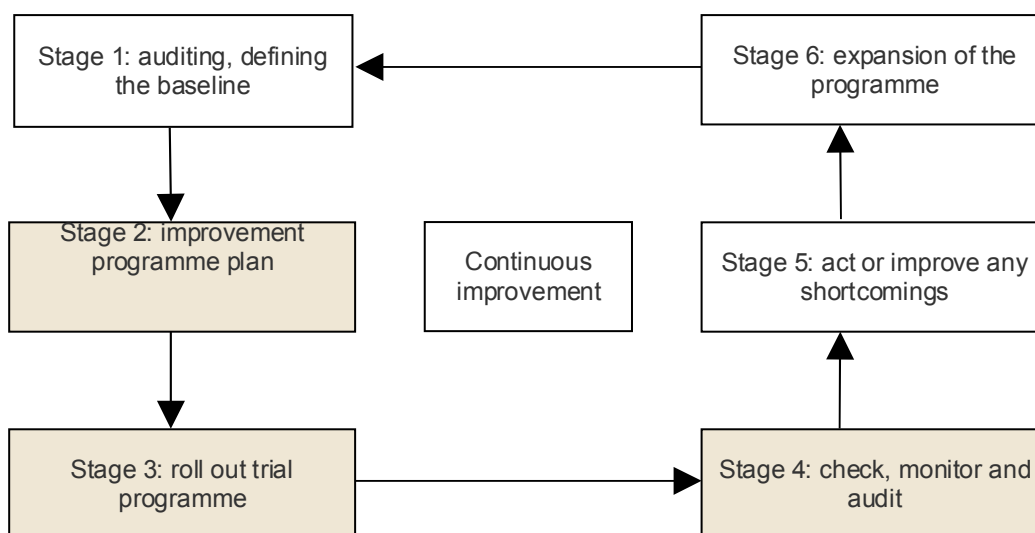
Waste streams can be audited using a variety of different methodologies. It may be necessary to use a combination of these to obtain an accurate understanding of the waste stream and where changes might be best made.

- The simplest method is to **observe and record practice**. This technique, in which items of waste are noted as they are entered into a receptacle, is broadly applicable across most waste streams and is particularly useful in developing an understanding of the effectiveness of waste segregation and any barriers to this. However, the process can be time consuming and care must also be taken to minimise observer bias.
- A second simple method is to undertake 'spot-check' **observations of waste receptacles**. The visual inspection is undertaken without removing the contents (for example, through the aperture of a sharps container) and allows identification of rogue waste items; however, quantification of the contents is not possible. Photographs can be taken to highlight good and bad practice.
- **Questionnaires** can be used to assess the understanding, attitudes and, to a lesser degree, the practice of staff with regard to waste management. Written carefully, they can also be useful to raise awareness. An example of the questionnaire used during the Waste Watch Weeks at the Renal Unit in the Queen Margaret Hospital, Dunfermline, is available here: www.greenerhealthcare.org/webfm_send/73.
- The gold standard audit tool is the **detailed analysis of waste through manual sorting**. This is used to determine the nature and composition of the waste items. The items should be sorted and recorded, using a table. The table below illustrates a method of itemising the contents of a clinical waste stream, and was developed by the Waste Watch team (www.wastewatch.org.uk):

Waste type	No. of items	Weight (g)
Paper (white)		
Paper (mixed)		
Cardboard		
Plastic bottles		
Mixed plastic		
Tins, cans & foil		
Organic (food)		
Other (specify)		
Total		
Total measured weight of bag (g)		

The weight or volume of the items should then be quantified. A thorough risk assessment prior to undertaking the audit is crucial.

Having completed the analysis, a report should be produced and recommendations made. Communication of this report improves staff awareness and encourages future involvement. It should be remembered that waste auditing forms a component of a cycle of continuous improvement.



Contact for Waste Auditing

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These case studies and guides can be accessed online and downloaded from www.greenerhealthcare.org/nephrology-resources/reduce-reuse-recycle