Sister Earth, Our Common Home: Toward a Sustainable, Planet Friendly Approach to Dialysis, a Paradigm of High Technology Medicine

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In our high-technology, highly polluted world, medicine plays an important role balancing saving lives with the expenses of growing amounts of waste products, not only biologically dangerous (the potentially “contaminated” or “hazardous” waste) but also potentially harmful for the planet (nonrecyclable, plastic waste). Dialysis, the prototype of high-technology medicine, is central to these problems, as the present treatment of about 2 million patients produces an enormous quantity of waste (considering hazardous waste only about 2 kg per session, with 160 sessions per year, that is 320 kg per patient, or about 640,000 tons of hazardous waste per year for 2 million patients, roughly corresponding to 6 nuclear aircraft carriers). Furthermore, obsolete dialysis machines, and water treatments are discharged, adding to the “technological waste.” Water produced by the reverse osmosis is also discharged; this is the only nonhazardous, nonpolluting waste, but in particular in dry areas, wasting water is a great ecologic concern. The present review is aimed at discussing strategies already in place and to be further implemented for reducing this particular “uremic toxin” for the earth: dialysis waste, including dialysis disposables, water, and dialysis machines.

Introduction: A New Awareness

“THE URGENT CHALLENGE to protect our common home includes a concern to bring the whole human family together to seek a sustainable and integral development, for we know that things can change.”¹

Regardless of personal beliefs, the recent “green” encyclical letter marks an important cultural change in the awareness of the problems that our beautiful, polluted, and endangered world is presently facing. Similar words on the need to preserve our planet, for the sake of all living creatures, were expressed by the Dalai Lama.²

The problems of pollution are not merely because of an increased quantity of waste produced as a “side effect” of an increasingly technological society, they also reflect a deeper cultural attitude, the so-called throwaway society, a term coined in the 50s, and presently defined in the Collins Dictionary as “a society full of excessive consumption and waste of food, products, etc.”³⁴ As clearly stated in the same letter, “These problems are closely linked to a throwaway culture which (...) quickly reduces things to rubbish (...). A serious consideration of this issue would be one way of counteracting the throwaway culture which affects the entire planet (...)”¹

This attitude toward substituting old with new, instead of modifying, adapting, and updating is well represented in Medicine, where the problem has 3 main facets: hardware (in the case of dialysis, this includes machines, water treatment equipment, and so on), disposables (in dialysis, the dialysis supplies), and energy and water. Even if attention, still clearly insufficient, is mainly paid to disposables, hardware and water also have to be considered “medical waste.” By definition, in fact, “medical waste is all waste materials generated at health care facilities, such as hospitals, clinics, physician’s offices, dental practices, blood banks, and veterinary hospitals/clinics, as well as medical research facilities and laboratories.”⁵ This broad definition comes from official documents, such as “the Medical Waste tracking Act of 1988,” which regulate the complex and expensive management of hospital waste.⁶–⁸ “Dialysis wastes that were in contact with the blood of patients undergoing hemodialysis, including contaminated disposable equipment and supplies such as tubing, filters, disposable sheets, towels, gloves, aprons, and laboratory coats.”⁸

Recently, the World Health Organization reports that “every year an estimated 16 billion injections are administered worldwide, but not all of the needles and syringes are properly disposed of afterwards” and calls for attention on the final destiny of all these waste products, that may be incinerated, producing dioxins, be discharged without...
any logic or rule. Indeed, while in rich countries waste management follows very strict rules, and its disposal is usually very expensive, in developing countries, the contamination issue may be exceedingly important (Fig. 1).

**Dialysis as a Waste Generator**

Dialysis is central to the complex issue of medicine and ecology: dialysis saves life. But dialysis, hemodialysis in particular, produces waste; an enormous quantity of waste that will increase; we need probably dialysis for 4 million people worldwide; we treat about 2 million patients.

Dialysis waste, as all medical waste, is divided into 2 main categories: hazardous waste, including all materials that were in contact with blood, and nonhazardous, or noncontaminated waste, which could be recycled or reused. Overall, the cost of disposal of hazardous waste is 10 to 30 times higher than for nonhazardous waste.

Considering the average weight of waste products from disposable materials, 2 million chronic hemodialysis patients produce over 2 million tons of waste per year that includes over 600,000 tons of potentially hazardous waste. Numbers are sometimes difficult to imagine, but, if we focus on the hazardous waste, that cannot be recycled considering that 1 African elephant weights about 5 tons and 1 adult giraffe about 1 ton, we might imagine 120,000 hazardous garbage elephants or 600,000 hazardous garbage giraffes each year. If we prefer a comparison with a man-made object, the yearly bulk of hazardous dialysis waste is equivalent to 6 CVN-69 nuclear aircraft carriers.

The ecological impact of dialysis waste is not limited to the hazardous ones, but also includes that of the “nonhazardous” waste that, even if mainly consisting of plastic and paper, presently undergo recycling cycles (usually “downcycling”) only minimally.

From an economical point of view, in countries where waste disposal follows specific rules, the cost of hazardous waste disposal (ranging from 1 to 5 USD per kg) is highly relevant and may almost equal that of new materials, if waste differentiation is not done. In fact, in the absence of differentiation, all waste products of a dialysis session, whether or not in contact with blood or body fluids (the same is true for the surgical waste), have to be considered as hazardous.

The costs of waste disposal vary widely across countries and may show important differences within the same country; the present European average for hazardous waste disposal is about 2 EUR (about 2.5 USD) per kg, with peaks up to 5 EUR per kg; meaning that, if differentiation is not correctly done and if all the leftovers of the dialysis sessions are discharged together, the price of waste disposal may almost equal to those of new materials.

**The Cradle to Grave Life Cycle of Dialysis Waste**

The first studies analyzing the destiny of man-made objects led to define the so-called “life cycle of the objects.” This is summarized by “take-make-waste”: take resources, make things, and destroy them.

The life cycle of dialysis material is an example of the cradle to grave life cycle, a cycle that is intuitively bad for the environment, but whose deleterious effects may be mitigated both by a wiser use of nonrenewable resources and by attention to the “destruction” phase. Studying the classical cradle to grave “history” often starts from the grave, tracking back the different steps of the life cycle; this reverse pathway is of particular interest in the case of dialysis, since the last phase, the waste disposal, is directly managed in the dialysis ward, under our supervision.

This is the pathway we followed for the analysis of dialysis waste management in a small dialysis ward; in this study, we aimed to assess the costs of waste disposal and potential for recycling; we calculated that the amount of plastic waste that is produced per dialysis session ranges from 1.5 to 8 kg (from 1.1 to 8 kg of potentially hazardous waste), partly depending on the type of dialysis machine and supplies, but mainly depending on differentiation of the waste products and policies toward emptying of the liquid waste, such as residuals of the saline solutions or water added to the bicarbonate cart.

Interestingly, “wise” differentiation, including also careful emptying of fluids trapped into the dialysis supplies, is not particularly time consuming: a trained nurse can complete the procedure in 1 minute for bicarbonate dialysis and in 2 minutes for hemodiafiltration. Differentiation is not a matter of time because careful management requires <10 minutes of nursing time, over an average dialysis shift, that includes about 15 minutes for the setup of the machine, 4 hours of dialysis and about 5 minutes for the restitution phase, followed by 10 minutes for the compression of the fistula.
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