REDUCTION OF PLASTIC WASTE IN HOSPITALS: UNDERSTANDING WHY CHANGE IS NEEDED AND HOW TO IMPLEMENT IT

By

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DEDICATION

To my wonderful mother, Valerie, my proofreader for yet another degree; my father, Lyle, who never was able to see me have a real job; to my wife, Amy, who worked extra shifts to make it possible for me to finish my degree on time; and to our daughter on the way who better stay in until graduation.
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Abstract

Illnesses related to pollution have been estimated to cost about $250 billion annually and are responsible for 50,000 to 100,000 deaths per year in the United States alone (Agwunobi, 2007). The financial costs of these diseases can be avoided if industries and individuals were more responsible with their waste. Medical institutions are not free of blame; they, too, are responsible for waste that can harm the population they serve to protect. Plastic is ubiquitous in hospitals; its creation and degradation are responsible for various chemicals that are known carcinogens that interfere with the human endocrine system. This summary of evidence will provide methods to ease the installation of a plastic waste reduction program in hospitals by providing background information on the environmental and health hazards the waste creates. It can be used as an education tool for staff members together with stage-matched interventions based on Prochaska’s Transtheoretical Model that can be used by hospital policymakers and a taskforce of motivated staff members.
CHAPTER ONE

Illnesses related to pollution have been estimated to cost about $250 billion annually and are responsible for 50,000 to 100,000 deaths per year in the United States alone (Agwunobi, 2007). Reduction of plastic waste can lower the levels of air and water contamination and, therefore, reduce pollution-related diseases. In the past few years, there has been an exponential growth of dialogue on ways to improve the condition of the environment from legislative discussion to frequent references on prime-time television. There are even businesses that are solely devoted to promoting and helping individuals and companies embrace this “green” lifestyle. The realization that strong environmental health is essential for keeping individuals healthy and that adverse health effects are prevented by avoiding exposure to hazardous materials led the United States Department of Health and Human Services (USDHHS) to include environmental health and quality as one of its largest and most complex focus areas for the Healthy People 2010 and 2020 campaigns (Agwunobi); in fact, it is one of the “ten leading health indicators” (USDHHS, n.d.).

The campaign lists geographic location as one of six major factors that contribute to health disparities among Americans (HP2010, n.d.) – making individuals closer to pollution more susceptible to disease. Non-governmental agencies such as the Institute of Medicine (IOM, 2001) offer goals for healthcare in the 21st century that are safe; “avoiding injuries to patients from care that is intended to help” (IOM, n.d., p. 6); effective and patient-centered – “care that is respectful of and responsive to individual… preferences” (p. 6); and efficient – “avoiding waste of equipment, supplies” (p. 6). By decreasing the amount of hospital waste in landfills and the pollution caused by unnecessary incineration of plastic materials, hospitals can minimize their impact on local air, water, and soil quality, subsequently improving the health and safety of the
population they serve. The IOM also desires attention to be placed on a variety of “priority conditions” (p. 10) such as cancer, diabetes, emphysema, asthma, and dementias [which have been tied to polluted water, air, and soil from contaminants that have leached from plastics (Armstrong, 2005; Harris et al., 2009)]. The IOM recommends that healthcare stakeholders such as healthcare organizations, consumers, and medical professionals develop plans to achieve quality improvement regarding these diseases. This outcome can be accomplished through a “green” program whose success is measured by the reduction of material known to pose environmental and human health risks. Healthcare providers are one of the best sources for improving the environment; they play active roles in policy creation and comprehend pollution-related illnesses, and their clinical practice can impact the environment. In fact, nursing is one of the most trusted professions (Harris et al.). Nurses can, therefore, be leaders in implementing an environmentally responsible program (Armstrong and Harris et al.).

Although there is some information on organizational barriers to implementing environmentally responsible (“green”) programs, information on individual barriers for engaging in responsible behavior or studies on implementation of green healthcare programs is lacking. This information is needed to help facilities benchmark successful strategies. A recent article on the psychological aspects of green healthcare has uncovered the belief on the part of management that spending money to green hospitals is not fiscally wise (Betterbricks, n.d.). There are, however, a number of recent studies and reports that emphasize that money is saved by hospitals “going green” (Jerrard, 2006, Mulder, 2008, Topf, 2005, Betterbricks, and Gosselin, 2008). Green healthcare can save money (Betterbricks). Due to the world’s present financial problems, many facilities are seeking ways to save money. The current financial crisis has opened doors for environmentally responsible programs. The American Recovery and
Reinvestment Act of 2009 offers grant money for programs that can be rapidly implemented; are related to “green” industry or energy-efficient; reduce greenhouse gases, create jobs, and have return on investment” (HDR, 2009).

The purpose of this report is to provide an all-inclusive resource that explains the environmental health hazard posed by plastic waste created by hospitals and to present time and cost reduction methods that can be incorporated into hospital protocols with the help of a facility-wide environmental taskforce, or green team.

Statement of Problem

Healthcare facilities are in the business of protecting individuals from disease and harm; however, they are a leading source of waste, including toxic waste that can eventually harm the individuals they aim to protect (Armstrong, 2005; Jerrard, 2006; Mulder, 2008). It is hypocritical for facilities that promote human health not to take preventative action to improve environmental health. Plastic materials are often overlooked sources of hazardous material. Reduction of non-recyclable plastic waste and recycling of plastic reduce the risk of harmful byproducts from the incineration and degradation of plastic such as cadmium (Kawamura et al., 2006), phthalates, dioxins (DiDiego et al., 2005) and Bisphenol A (BPA) from leaching into ground water and polluting the air (Lang et al., 2008).

Overview of Problem

A progress review of data from July 2007 on the goals of Healthy People 2010 reveals that water pollution (including dioxins and heavy metals such as cadmium) and fish contamination levels are not reaching the target goals set by the USDHHS. Contamination of fish is an indicator for Healthy People 2010 to evaluate clean water (Agwunobi, 2007). It shows that pollution of United States’ fresh water supplies – streams, rivers, and lakes – has worsened
Currently, not all results from Healthy People 2010 are available, but it is unfortunate that categories that gauge the quality of the United States’ freshwater supplies (HP 2010 8-8 and 8-10) have been removed from the final results of Healthy People 2010 and appear to have been archived at this time from Healthy People 2020 due to difficulties in the ability to measure progress for Healthy People 2010 (USDHHS, 2009). The objectives set by the Healthy People 2010 initiative did not coincide with available data from the EPA’s Department of Water (USDHHS). However, upstream attempts to increase municipal waste recycling (HP2020-4) and reduce the amount of chemical pollutants being released into the environment (HP2020-15) can improve water conditions (USDHHS, 2009). Along with the plastic pollutants cadmium and dioxins, it is currently suggested that bisphenol-A be added to the list of environmental pollutants (HP2020-21) that need to be reduced through efforts of Healthy People 2020 (USDHHS, 2009).

Hospitals use an exorbitant amount of plastic including packaging, IV equipment, and beverage containers. Recent research shows that harmful by-products from degrading plastic such as Bisphenol A (BPA) are leaching into our fresh waterways and accumulating in the air (Lang et al., 2007). BPA interferes with the human endocrine system, and high levels have been linked to cancers, heart disease, and diabetes (Lang et al.). The chemical DHEP – a compound used to make plastic IV tubing flexible – can affect human hormones and cause developmental problems (Armstrong, 2005). Plastic incineration releases dioxins and the heavy metal cadmium into the air and local water supplies (Armstrong). Dioxins and cadmium are carcinogenic (Armstrong; Unknown, 2005; Wild, Bourgkard, & Paris, 2009). Cadmium has also been shown to cause neuromuscular and mental disease (Armstrong).
Medical and infectious waste often attracts the most attention during discussion of hospital refuse. However, this hazardous material comprises only 15% of hospital waste generation (EPA, 2002). When the other 85% is broken down, paper and plastic are the two top contributors at 45% and 15% respectively (EPA). Many hospitals are currently recycling office paper and cardboard and researching ways to reduce paper waste (Lee et al., 2001). Paper production and the ink printed on the paper can involve toxic chemicals (Armstrong, 2005) but, as more and more hospitals turn to electronic medical records and computers to store information, paper waste will continue to lessen whereas the plastic waste problem appears to be increasing. An increase in plastic waste and a decrease in organic waste have been determined through random uniform sampling in landfills over the past 20 years (Papachristou et al., 2009). It is important for hospitals to do their part in reversing this trend and improving the health of the individuals they care for by reducing plastic use and its waste.

The major sources of hospital plastic waste are cafeterias, operating rooms, laboratories, and facility departments (Lee et al., 2001). Not only does the average hospital cafeteria create the most plastic waste in hospitals, but its lack of exposure to blood-borne pathogens and toxic chemicals found in other parts of the hospital makes it one of the easiest and most lucrative areas to reduce and recycle plastic waste (Lee et al.). Facility departments create a large amount of plastic waste from the packaging of purchased items. They also generate a significant amount of plastic waste themselves (EPA, 2002); large hospital facility departments often use a distribution center that further wraps or rewraps materials when they are routed to other areas of the hospital (EPA). Because materials from other hospital departments such as laboratories, operating and emergency rooms are hazardous, recycling the plastic becomes more complicated. Here, reduction of waste is most important as is preventing exposure of recyclable plastic to hazardous
materials. Opening recyclable plastic packaging such as the overpouch from IV bags before going into a patient’s room (Lee et al.) and sorting sterile blue wrap prior to an operation could greatly reduce waste (EPA, 2002; Cal/EPA, 2007). The other major source of plastic waste in hospitals is items that go into sharps’ containers as well as the container itself (Lee et al.).

Table 1 summarizes the location of certain plastic materials in hospitals and their associated health risks. By reducing these materials, local healthcare facilities can break the cycle of endangering public health and creating disease in the clientele they work hard to keep healthy every day. With the reduction of hospital waste, further research will be necessary to determine reduction (if any) in rates for cancer, diabetes, heart disease, (Armstrong, 2005; Lang et al., 2007), neuromuscular and mental diseases (Armstrong), emphysema and other pulmonary problems (Armstrong) as well as in levels of air, soil, and water pollution. Apart from wasting and destroying natural resources, poor environmental practice can also be fiscally wasteful. With current financial problems and increased government spending on “green” programs, now is the perfect time to link financial gain with social responsibility by instilling “green” behavioral changes in departmental staff.
### Table 1 Plastic Type, Harmful Components, and Associated Health Risks

<table>
<thead>
<tr>
<th>Plastic / Location</th>
<th>Toxic Elements and Disorders(^a)</th>
<th>Considerations</th>
</tr>
</thead>
</table>
| Polyethylene terephthalate (PET or PETE), #1 | Antimony – dizziness, depression, and death\(^7\)  
Phthalates – possible carcinogen | Do not reuse (increases exposure to toxic elements)\(^8\), avoid extreme temperatures\(^6\), and juice containers may have higher levels of antimony\(^2\) |
| Soft drink and water bottles, some food and liquid containers\(^1,3\) | | |
| High density polyethylene (HDPE), #2 | None known as of yet\(^1\) | Better choice for reusing if using plastic as a food or beverage container\(^1\) |
| Milk and water bottles, chemical and soap containers, buckets, sharps\(^s\) containers, recycling bins, grocery-type bags, and IV bag overpouches\(^1,3\) | | |
| Polyvinyl chloride (PVC), #3 | DEHP (a phthalate) – liver damage, obesity, diabetes\(^7\)  
Other phthalates – early puberty in females, low sperm counts, testicular cancer, hypospadias, endometriosis, and shorter gestation\(^7\)  
PCBs – cancer, thyroid swelling, and endocrine disruptor\(^4\)  
Dioxins – cancer, infertility, learning disabilities, birth defects, endometriosis and immune suppression\(^3,4,6\)  
Cadmium – renal abnormalities, carcinogen, and lung problems\(^3\)  
BPA – cancer, heart disease, diabetes, and endocrine dysfunction\(^3\) | Avoid\(^3\) |
| Cling wraps, pipes, IV and blood bags, gloves, and IV tubing\(^1,3,4\) | | |
| Low density polyethylene (LDPE), #4 | None known as of yet\(^1\) | Better choice for reusing if using plastic as a food or beverage container\(^1\) |
| Plastic bags, solid and liquid containers, IV tubing, various lab equipment, and food packaging\(^1,3\) | | |
| Polypropylene (PP), #5 | None known as of yet\(^1\) | Better choice for reusing if using plastic as a food or beverage container\(^1\) |
| Reusable food containers (Tupperware, Rubbermaid, etc.), dishware\(^1,3\) | | |
| Polystyrene (PS), #6 | Styrene – possible carcinogen\(^3\) | Do not use for reheating (especially Styrofoam)\(^3\) |
| Surgical bluewrap\(^6\), common cafeteria plastic: cups, lids, trays, plates, utensils, and Styrofoam carriers\(^1,3,7\) | | |
| Other (O), #7 | BPA – cancer, heart disease, diabetes, and endocrine dysfunction [found in polycarbonate (PC) type #7]\(^3\) | Avoid use, especially reuse. Avoid extreme temperatures. Wash with mild detergent and rinse well\(^3\) |
| Baby bottles, packing material, plastic wrap, and lining in food cans\(^1\) | | |

\(^a\) Please see www.epa.gov/iris/ for studies revealing observable adverse effects; \(^1\) Lee, Ellenbecker, & Moure-Eraso, 2001; \(^2\) Hansen et al., 2010; \(^3\) DiDiego, et al., 2005; \(^4\) unknown, 2002; \(^5\) Pelley, 2008; \(^6\) EPA, 2002; \(^7\) Melamed & Wilburn, 2001)
CHAPTER TWO

Various suggestions have been offered to reduce the environmental impact of hospitals through the reduction of plastic waste. Specific recommendations will be included in the hospital-wide program proposed in the final chapter of this report. This literature review focuses on known barriers to change and the methodology needed to develop and implement a successful hospital-wide environmentally-friendly program.

Barriers for Change

Being aware of the perceivable barriers in an institution, reducing plastic waste is essential to understand prior to implementation of any changes. The acknowledgement and addressing of barriers can encourage changes to be incorporated more easily and more rapidly (Moulding et al., 1999). Various laws determine how and what type of material can be recycled, especially when pharmaceuticals and infected materials are involved. Awareness of these can uncover ways to facilitate proper recycling and disposal as well as finding ways to prevent plastic waste from being contaminated and losing its recycling potential (Lee, 2002; EPA, 2002). Legal obstacles play a minor role in barriers. Topf (2005) states that the largest barrier to overcome when implementing environmentally responsible programs is the notion that the programs are expensive and do not save money. If managers do not appreciate the need for plastic waste reduction or understand that their company/department can actually save money (Betterbricks, n.d.), they will not take the time to educate their employees or spend money on initial start-up requirements and manpower needed to complete necessary tasks. Just as managers may not appreciate the need, some employees may believe that separating plastic waste or worrying about trash is not part of their job or worth their time. The support of management is necessary to influence the opinion of their workers.
When looking at cost analysis methods, it is important to demonstrate that reduction of plastic waste is cost-effective for management, investors, and staff. Initially, it may be more expensive to implement measures to reduce plastic waste; however, it is possible to save money over time and also create a self-sustaining program. When analyzing costs of programs, it is important to use a “lifecycle” approach where costs versus savings are evaluated (BetterBricks, n.d.). The federal government has used this approach in developing environmentally friendly projects, and now “almost all federal construction projects are incorporating… sustainable features” (Christian, 2004, p.222A). Functional cost analysis (FCA) studies can be used to analyze the costs of components in a plastic waste reduction program, and its value can be determined by the customer (staff that are implementing the program and/or carrying out its goal). Simultaneously, FCA can improve the program’s value by maintaining the cost (or reducing the cost) of the program and creating self-sufficiency and increasing departmental profits (Brusse-Gendre, 2002). According to Brusse-Gendre, FCA should begin during initiation of programs and include benchmarking similar successful programs. When determining value, Brusse-Gendre states that it is also important to evaluate other alleged “values” that may not improve function such as “esteem value” – aesthetic value – and “market value” – where something is chosen over another even when they are equal. Along with FCA, cost-benefit analysis is a simple method of determining if the benefits outweigh the costs of a given project (Chang & Bartlett, 2001). Its equation “Total Benefits – Total Costs = Net Benefits” can be used to prove that an environmentally responsible program is not only socially responsible but a financially self-sustaining idea as well. After consultation with local suppliers, hospital purchasers, and waste management companies, dollar values can be assigned to various expenses and revenues to complete the cost-benefit analysis to be presented to management and investors.
Making an Organizational Change

There are two main reasons why advanced practice nurses (APNs) need to be involved in environmentally friendly programs that reduce plastic waste. Almost all hospital policies are devised and/or evaluated and set forth by nurse managers, nurse educators, and house supervisors (all APN roles). Because APNs are often in charge of corporate policy creation (Grady & Johnson, 2009), it is important that they be involved in the training and the implementation of the program as well as working on its evolution. Secondly, most hospital education programs are provided or guided by APNs that are nurse educators. Nurse educators are excellent resources for the education of nurses, and their expertise is necessary in developing promotional aids such as classes, surveys, signage, and program evaluation as well as in its evolution as changes, problems, and new evidence-based practice methods arise. Success rates of programs can increase through the expertise of various APN roles and the use of organizational change theories, such as the Transtheoretical Model.

Transtheoretical Model (TTM)

Governmental laws and pressure can encourage specific actions on the part of individuals as well as change opinions on positions regarding environmental healthcare and the installation of “green” practice (Topf, 2005). An example of this would be the drastic reduction in mercury waste in the 1990’s due to pressure from state and federal laws (MPCA, n.d.). However, behavioral change may still need to be encouraged within an organization. A database review was completed in an attempt to uncover an appropriate health promotion theory for organizational and/or individual change. CINAHL, MEDLINE, and Google scholar database searches using combinations of the following keywords: theory, model, framework, green, environment, plastic, recycling, hospital, waste, initiation, organization(al), individu(al), change,
behavior, and pollution did not reveal any information regarding behavioral change theories used for initiating recycling or “green” healthcare programs.

Adapting ideas from organizational behavioral change theories, such as the Transtheoretical Model, are helpful when implementing an environmentally responsible program. Prochaska et al. (2001) propose how to adapt TTM, which was originally based on individual change, for the purpose of organizational change. It still uses the idea of creating a framework to integrate leading organizational change theories (Prochaska). Determining an organization’s “stage of change is the central organizing construct of TTM” because “stage-matched interventions” can be used to facilitate the proposed change more successfully (Prochaska, p. 251). The stages and there explanations are listed in Table 2.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Definition of Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precontemplation</td>
<td>not intending to take action within 6 months</td>
</tr>
<tr>
<td>Contemplation</td>
<td>intending to take action within 6 months</td>
</tr>
<tr>
<td>Preparation</td>
<td>intending to take action in next 30 days</td>
</tr>
<tr>
<td>Action</td>
<td>made overt changes less than 6 months ago</td>
</tr>
<tr>
<td>Maintenance</td>
<td>made overt changes more than 6 months ago</td>
</tr>
</tbody>
</table>

(Prochaska et al, 2001)

“Stage-matched interventions” have been previously proven to have more impact on change than “one-size-fits-all” programs because they increase the level of participation (Prochaska et al., 1993; 2001) as well as reducing stress, resistance, and implementation time (Prochaska, 2001).

Identifying the barriers that inhibit the installation of plastic waste reduction is absolutely necessary. APNs and other hospital staff in charge of writing policy need to be aware of both governmental laws regarding hospital waste and organizational barriers which include the beliefs management and staff have regarding such a program. Through the use of the TTM, APNs can
identify these barriers and provide appropriate interventions to implement a successful plastic waste reduction program.
CHAPTER 3

Once the institutional barriers are uncovered, a functional cost-analysis can show that a plastic reduction program is feasible in a hospital. The Transtheoretical Model (TTM) can be used by APNs to identify the steps needed to implement a program that can reduce the hospital’s impact on health hazards created by the release of toxins in plastic waste. In an effort to change clinical practice, Moulding et al. (1999) use the TTM to identify the steps to implement their plan for behavioral change. A modified 4-step version of their implementation plan based on TTM strategies can be used by APN’s to develop an effective plastic reduction program.

Moulding et al.’s modified steps for the program are as follows, Step 1: *assessment of staff’s readiness to change and specific barriers*; Step 2: *determination of appropriate level of intervention*; Step 3: *implementation strategies*; and Step 4: *evaluation*.

**Program Implementation**

Following the advice of Brusse-Gendre (2002), functional cost analysis should be done during early planning stages of a program’s implementation. The taskforce initiating the program, or “green team” (Jerrard, 2006), should gather individuals from various backgrounds including nurses, doctors, housekeepers, and pharmacists. The taskforce will introduce the proposed environmentally responsible plastic waste reduction program and ask for ideas as to what can be done to improve each department’s practices as well as any barriers that may hinder the project. With the implementation of the American Recovery and Reinvestment Act of 2009, grant money is available for self-sustaining programs similar to the one proposed (HDR, 2009). Investing matching money in supplies and hourly wages to establish a motivated “green” taskforce and program can be helpful in obtaining more governmental funds. Money saved with the waste reduction program can be reinvested in the program; used to create other
environmentally friendly programs (such as solar panels, composting, battery recycling and water reduction methods); returned to investors as profit, or given to staff in the form of raises and year-end bonuses. Task Force activities related to each step will now be described.

**Step 1: Assessment of staff’s readiness to change and specific barriers.**

In order to determine what “change stage” (precontemplation, contemplation, or preparation) the hospital staff is in, an initial survey will be handed out to staff throughout various departments to determine current practice techniques, knowledge of staff, how apt to change they are as well to uncover any perceivable barriers. (Prochaska, 2001).

**Step 2: Determination of appropriate level of intervention.**

Upon review of the survey (preparation stage), an organizational team including managerial APNs and nurse educators will determine the “stage of change” (such as contemplation vs. preparation) and discuss proposed “stage-appropriate changes” of the TTM (Prochaska, 2001) prior to initiation of the educational program. Once the organization has moved to the action stage, guest speakers from the Healthy People 2020 initiative, local plastic recycling centers, and/or an expert on environmental toxins and their impact on human and environmental health can be invited to present an educational forum on “Environmental Health.” (Mejia et al., 2009).

**Step 3: Implementation strategies.**

A small identified group of staff already in the preparation stage can serve as the taskforce (Prochaska, 2001) that establishes and furthers the plastic reduction program. These early adaptors can motivate other staff members to progress from precontemplation and contemplation stages to the preparation stage through “stage-appropriate” interventions identified by Prochaska. These interventions include “helping relationships”, “stimulus control”,
and “reinforcement management” (Prochaska). During program implementation, “helping relationship” strategies include taskforce member availability for answering questions as well as directly working with staff to ease the transition into the process of creating a facility that consumes less plastic. The taskforce can also use “stimulus control” strategies to facilitate staff compliance and adaption to change by adding more recycling bins in strategic locations for staff and signs that encourage recycling; as well as location of bins; encouraging staff to bring their own silverware and plates from home; and providing information to those in charge of purchasing on options that reduce packing material and other plastic waste. Eventually, as the program develops, the taskforce can use “reinforcement management” strategies. If, in fact, the department begins to save money, and bonuses, raises, and overtime are reinstated, staff should be reminded that it was their hard work and behavioral change that was responsible for these benefits. This may even encourage those most wary of change, those in the *precontemplation stage*, to adjust (Prochaska, 2001).

Simple changes to the hospital environment can prepare staff for more complicated behavioral change. One of the easiest ways to prevent plastic waste is to throw plastic into a recycling receptacle instead of a trashcan. Recycling of plastic should be made easy to facilitate staff, visitor, and patient compliance. Labeled plastic recycling bins should be distributed throughout the cafeteria and breakrooms. Pairing recycling bins with garbage cans together with nearby signs that promote recycling can decrease plastic waste. High-traffic areas throughout the hospital such as cafeterias, waiting rooms, and elevator lobbies also need to have plastic recycling receptacles as well as signs to direct individuals to their whereabouts in order to encourage participation. Each hospital department’s type of plastic waste requires specific
techniques to make plastic waste reduction successful. Below are specific considerations to address when beginning a plastic reduction program.

* **Cafeteria.**

Not only are cafeterias responsible for the majority of plastic waste created by hospitals, but the waste is also the easiest to sort (Lee et al., 2002). Because of this, it is important to initiate and/or focus plastic recycling programs in the cafeteria and food service areas. Some hospital cafeterias have made a conscious effort to use only one type of plastic (polystyrene) to make sorting easier, and this lowers the cost of recycling programs (Lee, et al.). These cafeterias purchase solely polystyrene plates, utensils, and cups and use companies that utilize only polystyrene as packing material (Lee). A problem with polystyrene is that many municipalities do not have programs that recycle this form of plastic (Lee). Awareness of outside recycling resources is necessary prior to initiation of any recycling program. Packing material can be returned to some vendors and manufacturers as “backfill” to be reused (EPA, 2002). Currently, there is mixed research regarding the safety of polystyrene regarding its creation, how it is degraded in the environment and the threat it poses (Bandyopadhyay & Basak, 2007 and Barry, 2009). Because of potential hazards from plastics and limited local resources for recycling certain plastics, it may be best to use reusable plates, silverware, cups, and trays; and for those who are taking their food off-site, containers composed of biodegradable materials would be the best option. Also, using organic biodegradable packing material such as plant fibers may pose an even better option than the use of plastics altogether. Organic biodegradable materials are better alternatives to plastics due to their lack of toxic chemicals; however, ideally, these materials need to be composted in order to be truly biodegradable. Biodegradable materials do
not generally breakdown in landfills due to the lack of oxygen and moisture required for this process to occur (Pommier, et al., 2008)

**IV bags.**

Melamed and Wilburn (2001) determined IV bags to comprise over 25% of the plastic waste created by hospitals. Most IV bags are made from polyvinyl chloride (PVC) (Lee et al., 2002). There is potential to recycle these bags, but local laws differ with regard to the contents of the bag, and education of staff is vital to prevent these IV bags from being incinerated, if possible, because of the toxic materials and heavy metals released into the environment during this PVC disposal process (Lee). It has been found that 90% of IV bags are not infectious or contaminated (Lee), thus showing the need for proper sorting of material by staff to encourage recycling and avoid incineration and landfill. Bins specifically for IV bags in all parts of hospitals where IV fluid therapy is used will simplify recycling. There are IV bags on the market that do not contain PVC. These bags are preferred because they reduce pollution caused by PVC creation and waste and reduce direct health risks from exposure to toxic chemicals that may occur during IV therapy (Rossi and Schettler, 2000).

**Packaging**

Medical packaging waste is one of the top sources of plastic waste in hospitals (Lee, 2002). Responsible purchasing can play an important role in reducing waste by utilizing companies that use recyclable plastic packaging material. To decrease costs and increase ease of recycling plastic packaging, it is important, when possible, to reduce exposure to infectious material (Lee, and EPA, 2002). The overpouch of IV bags is generally made from HDPE (#2 plastic), and many centers recycle this form of plastic (Lee). These wrappers are found in all hospital departments. Having bins to recycle these overpouches in nurse stations, medication
rooms, and pharmacy areas before they are taken into a patient’s room can create a clean and easy way to sort this form of plastic waste. Because it can be difficult to recycle plastic packaging, ways must be found to reduce its usage. Since 1990, Kaiser Permanente has used reusable totes of various sizes in its hospitals to redirect materials from its central distribution center (EPA). The various sized totes allow for a reduction of plastic filler material. This example can be followed by facilities with more than one hospital campus that share a distribution center or even by individual hospitals on a small scale when moving equipment and material to various departments.

**Blue Wrap**

Another abundant form of plastic packaging in operating and emergency rooms is the blue wrap, polypropylene (#5 plastic), used to protect sterile surgical equipment. Research evaluating hospital programs to decrease blue wrap has uncovered a number of reduction techniques (EPA and Cal/EPA 2007). Some hospitals have found that it is difficult to locate nearby facilities to make recycling feasible due to the low value of polypropylene (EPA and Cal/EPA). Because of this, some have found it to be cheaper and less wasteful to use reusable metal sterilization boxes rather than plastic blue wrap (Cal/EPA). Other hospitals are near local recycling centers that can feasibly recycle blue wrap (EPA). Some operating rooms have added easily-sterilizable stainless steel frames (to hold trash bags) to collect blue wrap prior to surgery or in the sterile anteroom (EPA). Some hospitals have found that during the program’s progression, staff have discovered other forms of plastic wrap used by the hospital that can be recycled with blue wrap – thus decreasing further plastic waste (EPA).

**Sharps**
Sharps waste has a high plastic content – 85% – which provides a greater potential for recycling than other sources of waste created by hospitals (Lee et al., 2002). However, because of its infectious nature, recycling becomes more difficult. A few programs that mechanically open boxes, wash, disinfect, and shred material for reprocessing do exist (Lee). Because sharps’ containers are made of plastic, companies that disinfect the boxes and/or recycle them need to be utilized. Some hospitals have reduced their waste stream by 17 tons with this change alone (Wang, 2009).

**Step 4: Evaluation.**

TTM emphasizes the importance of evaluation, not only providing feedback to employees but for employees to provide feedback on the program (Prochaska, 2001; Moulding, 1999). These evaluations will improve the program and further encourage adaptation by staff (Prochaska). Progress of the program needs to be evaluated by the taskforce noting: decreased weight of trash removed by waste management; increase of recyclable plastic material leaving the facility; and any income from recycled material. This information should be shared with staff through charts and graphs on an information board in breakrooms throughout the hospital to show that the hard work of staff is making a difference.

**Cost Savings**

New laws that mandate cleaner living, with some cities (San Francisco, San Diego, and Pittsburgh) fining companies and individuals for not recycling (Merchant, 2009), as well as possible tax breaks are incentives and opportunities for companies that embrace environmentally responsible changes. Not only will some programs save money (reducing waste), but others may even earn money for facilities (recycling). The more money a company saves and earns, the more that may trickle down to employees in the form of bonuses. When it comes to garbage
removal from a facility, most pay for disposal by weight. By decreasing the amount of plastic hospitals use through reduction, reuse, and recycling methods, a hospital can save more money in garbage disposal and there is, in fact, an opportunity to make money on the material they had previously paid disposal fees on. In the late 1990s, average fees for waste disposal were $50 to $200 per ton (E Magazine, 2009). In some areas (including New York City), it was, initially, cheaper to throw all waste into landfills than to recycle. Unfortunately, this led to faster filling and closure of landfills which, subsequently, raised disposal fees due to the reduction in landfills (E Magazine). The initial money saved by not recycling turned out to be more fiscally expensive in the long run and forced these municipalities to restart their recycling programs (E magazine). Current disposal fees range greatly due to local taxes, availability of space, number of landfills in the area, and the distance to haul the refuse (E magazine; CIWMB, 2001; EPA, 1998). Specific examples on how plastic waste reduction has saved money will be discussed in further detail later in this chapter. Generally, PET (#1), HDPE (#2), PP (#5), and PS (#6) plastics are more easily recycled through heating and cooling processes (Goodship, 2007). However, most areas do not have recycling services for PP and PS (Lee, 2002). Because of this, it is best to use PET and HDPE, whenever possible, in order to get the most return on the waste. When plastic is sorted by type, it has the most value; therefore, it is important to have properly labeled bins that sort the various types of plastic to increase the value of the waste (Profitable Recycling, n.d).

Most information available on money that can be saved by recycling and reduction are on beverage containers and blue wrap. Table 3 provides examples of programs that saved money from plastic reduction.

*Beverage Containers*
At least 11 states including California, Hawaii, and Oregon have deposits on many of their beverage containers; the deposits are returned when the containers are recycled. Hospitals that purchase these containers for staff, patients, and visitors are throwing money away with the plastic if they do not recycle the containers. Along with the deposits, PET and HDPE plastic also have an intrinsic material value as well (Profitable Recycling, n.d). In the past few years, there has been an insurgence of vending machines that dispense plastic soda bottles. A suggestion for all hospitals, especially for hospitals in states that do not have deposit values on their plastic containers, is to use vending machines that dispense aluminum cans; not only does this reduce plastic waste, but it increases income for the recycling program because aluminum is worth more than plastic (Profitable Recycling).

Packaging and Blue Wrap.

Various case studies can be found in literature that discuss plastic waste reduction and the money that is saved. Four years since the initial purchase of reusable plastic bins for materials distribution, a northern California division of Kaiser Permanente (a managed-care organization) now saves $40,000 a year by using bins of various sizes that reduce extra plastic wrap, packaging materials, and man-hours (EPA, 2002). It is estimated that 20% of waste from surgical procedures is blue wrap (Cal/EPA, 2007). The California EPA (2007) has compiled two studies on reducing and recycling surgical blue wrap. With bins located throughout the hospital, one hospital recycled 5,595 pounds of blue wrap during the first year of the program. Another hospital found they had spent $36,000 a year on blue wrap. For $35,000, they were able to purchase stainless steel containers to replace 70% of their blue wrap. These containers can be used multiple times, thus saving hundreds of thousands of dollars as time passes; not to mention the amount of plastic waste that is avoided. A third hospital diverted 3.5 tons of blue wrap per
month from its waste stream and saved $400 in disposal fees (EPA, 2002). It donated the material to a local charity that picked up the material and recycled the waste for cash (EPA). This program creates positive public relations, saves money, and increases tax write-offs.

**Sharps**

It is estimated that a 1,000 bed hospital can reduce plastic waste by 34,000 pounds a year through utilizing companies that sterilize and reuse sharps’ boxes (Wang, 2009). This can save $175,000 annually by not having to purchase new containers and avoiding disposal costs (Wang).

**PVC**

In an attempt to lessen its negative environmental impact Kaiser Permanente is currently attempting to create PVC-free facilities (IOM, 2007). Serendipitously, the PVC-free flooring did not require the heavy coats of wax used on the old linoleum floors (IOM). This change eventually led to cost savings and further lessened their negative environmental impact through reduced usage of harsh chemicals (IOM).

Using the TTM to evaluate individual and organization readiness to change is necessary to create a successful plastic reduction program as well as provide an environment where it can survive and expand. Stage-matched interventions used by the taskforce can create a program that not only decreases plastic but saves money at the same time through the reduction of plastic waste created in cafeterias; recycling (when reduction is not possible) of beverage containers, IV bags, blue wrap, and packaging material; and using reusable sharps’ containers.
Table 3 Cost Savings

<table>
<thead>
<tr>
<th>Plastic Type</th>
<th>Comments</th>
<th>Money Saved</th>
</tr>
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| Blue Wrap¹   | • Reduction of 42 tons from waste stream  
• Material donated to local charity that hauls material to recycling facility | Yearly:  
$4,800 saved disposal costs  
- 3,000 spent on labor  
$1,800 saved |
| Blue Wrap²   | • Replaced 70% of blue wrap with reusable and sterilizable containers. | Hundreds of thousands of dollars is estimated |
| Packaging³   | • Reusable plastic boxes of various sizes  
• Decreased use of extra plastic packaging material and tape  
• Streamlined method also reduced man hours | $40,000 per year |
| Sharps⁴      | • 1,000 bed hospital  
• Uses reusable containers | $175,000 per year |

¹ EPA, 2002; ² Cal/EPA, 2007; ³ EPA, 2002; ⁴ Wang, 2009

**Future Research Suggestions**

Further research could test a program such as the one presented. The information obtained could help evolve the theoretical framework since there appears to be a literature gap on the topic of behavioral change theories and their helpfulness in implementing an environmentally-friendly program to reduce plastic. Retrospective studies of successful “green” programs could also reveal important information that can be used for creating a framework for behavioral change. Because of regional differences in laws, recycling facilities, and costs of waste disposal and recycling, it is hard to obtain a universal cost analysis. A study comparing regional costs, barriers, and promoters would be useful for proposing universal guidelines to create the most lucrative, safe, and environmentally friendly program. Quantitative studies that show the amount of toxins removed from the environment through a plastic waste reduction program and the subsequent theoretical effect on disease reduction would provide more
information to stakeholders and thus emphasize the importance for the need of plastic waste reduction and other environmentally responsible programs.

Conclusions

The plastic waste produced by hospitals is costly in terms of both monetary and health risk. Money saved by reducing, recycling, and reusing plastic material can be used to buy better equipment, provide more staff, and improve patients’ outcomes in other ways. Plastic waste and the pollution it creates physically harm the environment and, eventually, the individuals the hospital aims to heal and protect. Plastic is responsible for many cancers and endocrine disorders (DiDiego, et al., 2005 and unknown, 2002), contributing to the $250 billion annual cost and 50,000 to 100,000 deaths per year from pollution related illnesses (Agwunobi, 2007). Using a green taskforce and stage-matched interventions borrowed from the TTM, organizational change can reduce an organizations impact on this growing problem (Prochaska, 2001). During implementation of a program that reduces plastic waste, it is important to overcome the notion that environmentally friendly programs waste money; there are vast amounts of literature that disputes this claim (Topf, 2005). Apart from reducing a hospital’s impact on the environment, money will be saved by a well run waste reduction program. Plastic waste reduction is one of the less complicated changes a hospital can make to become more environmentally friendly. Infection control issues are recognized in a plastic reduction program that relies on plastic recycling as one of its main components. However, it is important to emphasize that only 15% of total hospital waste is considered infectious (EPA, 2002), and 90% of IV bags are non-infectious (Lee et al., 2002). This stresses the importance of reducing plastic exposure to infectious materials. With the help of advanced practicing nurses in policymaking roles and members of a green taskforce that use stage-matched interventions of the Transtheoretical
Model, behavioral change is possible. Simple behavioral changes, including throwing plastic into a recycling bin instead of a trashcan will make a difference. In fact, behavioral change on the part of staff to reduce plastic waste at work may also be adopted at home and spread to other family members and friends, thus furthering the power of the program. When staff and management see how productive and easy plastic reduction is, an organized, focused taskforce can go further to reduce organic, water, pharmaceutical, and energy waste throughout the hospital. These changes can be costly initially but will reduce the hospital’s negative impact on the environment and the individuals it serves.
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