sciendo

Environmental & Socio-economic Studies

DOI: 10.2478/environ-2019-0023

Environ. Socio.-econ. Stud., **2019, 7, 4: 45-53**



Original article

# How blameless are hospitals in climate change? An example of a province in Turkey

Manar Aslan[1]*, Ayşe Yıldız[2]

*[1]Department of Nursing, Faculty of Health Sciences, Trakya University, Edirne, Turkey*
*[2]Mersin University, Ciftlikkoy Campus, 33343, Yenişehir, Mersin, Turkey*
*E–mail address (*corresponding author): manaraslan@hotmail.com*
*ORCID iD: Manar Aslan: https://orcid.org/0000-0003-0932-5816; Ayşe Yıldız: https://orcid.org/0000-0002-0920-8030*

ABSTRACT

Starting from the 1970s, the discussion about the negative effects of human activity on the world has accelerated and with a increasingly raised voice and it has been noted that the natural balance of our world was being altered. The World Health Organization has focused its policies and directives on strategies aimed on dealing with climate change (and its impact on human health), and diseases related to air pollution and implementing health-related sustainable development goals in climate friendly-hospitals. Hospitals exist to treat patients, but they also pollute the environment because hospitals consume a lot of energy and water and produce hazardous waste. These organizations need to work hard to improve their carbon footprints. The study investigated practices at 21 public hospitals in Konya, Turkey. Results show that domestic waste was on average 54.83 tons per year, medical waste was 33.59 tons per year and packing waste was 24.36 tons per year. It was determined that medical waste disposal costs on average of €26,800 per annum, and the amount of medical waste per bed was 1.15 kilograms per annum. According to 2014 medical waste data the average medical waste per bed of these hospitals in Konya province is less than the average in Turkish public hospitals, in which it is 1.18 kilograms per bed. The hospitals in our study were found to be especially inadequate at water management and did not pay much attention to green practices.

KEY WORDS: climate change, green construction, hospital, carbon footprints, medical waste

ARTICLE HISTORY: received 8 July 2019; received in revised form 7 November 2019; accepted 13 November 2019

## 1. Introduction

One of the most disturbing effects of climate change is its potentially devastating effect on human health. According to the World Health Organization (WHO), a warmer and more volatile climate can lead to some air pollutants contaminating food, increasing the chances of extreme temperatures and endangering agricultural production in some less-developed countries. Most of the factors that cause mortality are climate-sensitive, such as cholera, diarrhoea, malaria, and other infections carried by vectors. In 2012, 12.6 million deaths occurred from these conditions, accounting for 23% of all deaths (PRÜSS-USTÜN ET AL., 2016).

If conditions continue, it is expected that climate change will lead to 250,000 additional deaths each year between 2030 and 2050 due to malaria, malnutrition, diarrhoea and heat stress. For this reason, the health sector can play an important role in ensuring that the adaptation of communities to climate change minimizes human health effects (WHO, 2017). In addition, the health sector is one of the most reliable and respected parts of the community and, at the same time, the largest employer and energy consumer. This proffers both a responsibility and an opportunity to demonstrate that action can be taken together with improving efficiencies and making cost savings to create climate neutrality in hospital processes. For this reason, hospitals can become pioneers by starting to reduce their carbon footprints to mitigate global climate change (NEIRA ET AL., 2008). In Turkey, 28 million tons of wastes were collected in 2014; there were 1498 hospitals and producing 74.495 tons of medical waste. In 2016, 31.5 million tons

of wastes were collected, from 1527 hospitals and 81.024 tons of which were medical waste. In 2017 there were 1525 hospitals which produced 85.987 tons of medical waste. In the other words, the amount of medical waste increased by 11.492 tons in three years (TSI, 2018). The European health sector has an impressive carbon footprint, and approximately 15,000 hospitals need energy for heating, lighting, ventilation, powering electrically driven devices, transportation and materials. In Europe, hospitals produce approximately 5% of the annual carbon dioxide gas emission (GGHH ANNUAL PROGRESS REPORT, 2014). In Europe, hospitals are responsible for 10% of the total energy use (ECONOMIDOU ET AL., 2011). In the United States, hospitals are the second-most energy-intensive commercial buildings, using 2.5 times more energy than other commercial buildings and producing approximately 30 pounds of carbon dioxide emissions per square foot (U.S. DEPARTMENT OF ENERGY, 2009). The healthcare industry worldwide spends $8.5 billion each year in order to meet the needs of patients. The UK National Health Service (NHS) has calculated hospital carbon emissions at more than 18 million tons per year, or 25% of total public carbon emissions (WHO, 2009).

Regulations should be implemented to avoid negative environmental effects of hospitals, from the design to the construction process before even providing services. During their operation, they should aim to save energy and water and to control waste and dangerous materials in order to establish a sustainable facility. Furthermore, the choices that affect the health of employees and patients - such as which paint to use on the walls, which ingredients to use in food prepared for patients and employees, etc. should also be taken into consideration because the fight against climate change is very important, and buildings providing healthcare services should not contribute to the problem. The physical and mental well-being of patients, work force personnel, visitors and local communities can be directly increased by means of the efficient design of buildings or use of land supporting local biodiversity (SAHAMIR & ZAKARIA, 2014). WHO has identified seven elements to climate-friendly hospitals (WHO, 2009):

1) Energy efficiency: Hospital energy consumption and costs are reduced with efficiency and conservation measures;

2) Green building design: A hospital should be built to respond to local climate conditions and is optimized for lower energy and resource demands;

3) Alternative energy production: A hospital produces and/or consumes clean, renewable energy on site to ensure its reliable and flexible operation;

4) Transportation: Hospital vehicles should use alternative fuels, and the use of alternatives such as walking, cycling and public transport by staff, patients and the community are encouraged;

5) Food: Sustainable local food should be provided for employees and patients;

6) Wastes: The hospital should reduce, reuse, recycle, compost and use alternatives to waste incineration;

7) Water: The hospital should make attempts to save water and to avoid the use of bottled water when there are safe alternatives.

Half of the work in the battling climate change is the renewal of hospitals and the other half is the change in the behaviors/habits of the employees (PINZONE ET AL., 2012). Healthcare professionals in the world -physicians, nurses, technicians, health care managers and public officials - are touched by the lives of people everywhere in society and are therefore important agents for change in large and small communities (WHO, 2009). For instance, nurses, the largest group of health care providers, are in an important position for protecting and improving health, as well as reducing environmental damage at home, in the hospital and in the community. The International Council of Nurses (ICN) indicates that global warming is an important issue for the nursing profession, especially in light of its effects on human health. It is the position of ICN to share protection and responsibility from the depletion, pollution and destruction of the natural environment (ICN, 2014). The majority of employees in hospitals are nurses, and they can use the following practices to reduce the carbon footprint of hospitals (GOODMAN, 2013):

1) Develop strategies for resource use in clinical practice and create alternatives for a lower carbon footprint.

2) Encourage responsibility in reducing energy/water consumption to lower the carbon footprint.

3) Produce less waste in nursing practice and ensure that these wastes are properly separated.

4) Create a “green team” and participate in this team.

5) Be an encouraging and supportive force for the hospital's climate-friendly initiatives.

6) Train and motivate the caregiver team regarding climate change and prepare supporting documents.

7) Help to encourage public transport for both patients and employees.

The aim of this study is to determine how climate-friendly state hospitals in a province in Turkey are.

## 2. Methods

This study has been carried out descriptively to determine to what extent green applications are executed in public hospitals in the largest province of Turkey (in terms of surface area). Included in the scope of the study were 21 public hospitals and a hospital that did not provide its data, which produced 1903 tons of medical waste in 2016 – eighth on a list of the 80 provinces producing waste. There are three kinds of hospitals in Turkey: public hospitals, university hospitals and private hospitals. Although university hospitals are of a larger scale, there are only one or two in each province, whereas the number of public hospitals affiliated with the Ministry of Health is much greater. This is the reason for using public hospitals in the study.

### 2.1. Data collection

The evaluation form was prepared with the help of various sources, particularly Health Care Without Harm, 'The 10 Agenda', the 'Green Guide for Health Care' etc. (GREEN GUIDE FOR HEALTH CARE, 2007; HERNANDEZ, 2016; PALTEKI, 2013; WHO, 2009). The questions were prepared using these ten goals, but some of the goals were eliminated during the preparation of the form due to a lack of standardization in the country (as in the questions about leadership, chemicals, pharmaceuticals and the materials used in the construction of the building), or because the actions were not commonly used (as in the questions about the usage of sustainable energy resources). The first part of the form collected information about the hospital - including the age of the hospital, the square-meter measurement of the total indoor and green areas, the annual number of surgeries and inpatients, the average amount of medical, domestic and packaging wastes - and posed 19 open-ended questions regarding sustainability initiatives. The second part of the form presented yes – or - no questions about waste management (22 questions), water management (11 questions), energy management (5 questions), material choices (3 questions) and sustainable facilities (6 questions).

### 2.2. Data analysis

With the data obtained from the yes/no questions, the position of a hospital were calculated in terms of its green practice performance (i.e. waste management, water management, energy management, material selection and sustainable facilities). The data requested in the green practice assessment form were obtained from presidents, vice-presidents or the chief physicians of the hospitals. There were some restrictions caused by a lack of records, especially for the open-ended questions.

### 2.3. Ethical approval

Ethics committee approval was gained from the University Ethics Committee for the implementation of the study (IRB No: 2016.05.31.2306- 2016/563).

## 3. Results

Twenty-one public hospitals with at least 25, and at most 790 beds, were included in the study (Table 1). A review of the physical features of the hospitals in the scope of the study found that they possessed approximately 29382 $m^2$ of housing space and 13824 $m^2$ of green space and that the average age of the buildings was 19 years. The average annual number of ambulatory patients in the hospitals was 263,800, the average number of inpatients was 8352, and the average number of surgeries was 6007 (Table 2). Only one of the hospitals, included in the study, had a housing space of less than 10,000 $m^2$ because the hospital is located in a city centre. The housing spaces of other hospitals were more than 10, 000 $m^2$. There were two hospitals that didn't have green space, and the hospital with the least green space was again the hospital located in the city centre.

Table 1. The hospital features related to physical structure

| n=21 | $\overline{x}$ | Sd | Min | Max |
|---|---|---|---|---|
| Area ($m^2$) | 29382 | 24499 | 4118 | 96500 |
| Closed area ($m^2$) | 15204 | 14720 | 2300 | 58204 |
| Green area ($m^2$) | 13824 | 20832 | 0 | 75177 |
| Parking capacity | 175 | 125 | 50 | 500 |
| Number of beds | 146 | 178 | 25 | 790 |
| Age of the building (year) | 19 | 20 | 1 | 75 |

Table 2. Hospital service indicators for one year

| n=21 | $\bar{x}$ | Sd | Min | Max |
|---|---|---|---|---|
| Number of ambulatory patients | 263800 | 386378 | 12000 | 1655000 |
| Number of inpatients | 8352 | 13277 | 150 | 51250 |
| Number of surgeries | 6007 | 11627 | 0 | 51000 |
| Occupancy rate (%) | 55 | 24 | 16 | 98 |

When looking at the waste produced by the hospitals, the study found that domestic waste was an average of 55 ton/year, medical waste was 33.6 ton/year, packing waste was 24 ton/year and vegetable oil waste was 294 l/year. The average medical waste disposal cost was €26,799, and the amount of medical waste per bed was 1.15 kg (Table 3). The annual resource consumption amounts of the hospitals showed that the average annual water consumption was 34,780 tons, average electricity consumption was 1,409,851 kW, and the average amount of natural gas used for heating was 206,588 $m^3$ (Table 4).

Table 3. Distribution and cost of waste

| n=21 | $\bar{x}$ | Sd | Min | Max |
|---|---|---|---|---|
| Domestic waste (ton/year) | 55 | 149.2 | 3 | 700 |
| Packaging waste (ton/year) | 24 | 39.6 | 1 | 150 |
| Medical waste (kg/year) | 33597 | 70222.6 | 1000 | 324209 |
| Battery waste (box/year) | 2.40 | 2.7 | 0 | 10 |
| Vegetable oil waste (l/year) | 294 | 443.5 | 0 | 1514 |
| Medical waste cost (€/year) | 26799 | 58915.5 | 838 | 271730 |
| Amount of medical waste per bed (kg) | 1.15 | 0.82 | 0.03 | 4.09 |

Table 4. Annual consumption of resources

| n=21 | $\bar{x}$ | Sd | Min | Max |
|---|---|---|---|---|
| Water consumption (ton/year) | 34780 | 39458 | 1208 | 175000 |
| Electricity consumption (kW/year) | 1409851 | 2137389 | 116900 | 9109000 |
| Used charcoal for heating (ton/year) | 29.71 | 54.8 | 0 | 230 |
| Used fuel oil for heating (l/year) | 9782 | 21533 | 0 | 68660 |
| Used natural gas for heating ($m^3$/year) | 206588 | 319610 | 0 | 1190000 |

Table 5 shows the hospitals' answers to the questionnaire by percentage. The results show that all the hospitals have a comprehensive waste management plan, medical waste storage, and guidelines for gathering, sorting and storing and that they conduct internal inspections, follow guidelines for quality health care services, store hazardous waste appropriately and provide regular training about waste management for employees. Regarding water management, sanitary systems are regularly inspected in all of the hospitals in order to prevent leaks. However, only one of the hospitals was collecting rain water, only five of the hospitals turned off water systems automatically when it rained, only six of the hospitals discharged the photochemical originating from X-ray devices under proper conditions, and only seven of the hospitals used double-stage toilet tanks. In terms of energy management, it was found that all the hospitals are working to reduce energy consumption and ensuring that electronic devices are chosen from low-energy consuming devices (Class A). In materials management, recycled materials were used somewhat, and the hospitals also paid attention not to use canned or frozen foods. In sustainable facility management, the hospitals reported that the number of windows they possess is just enough for lighting, they have natural air-conditioning possibilities, the transportation to the hospitals is provided via public transport and the area for the car park is sufficient.

Table 5. Percentage responses to the questionnaire for hospitals

| Waste management questions | Yes | | No | |
|---|---|---|---|---|
| | N | % | N | % |
| Hospital has a comprehensive waste management plan | 21 | 100.0 | 0 | 0 |
| The units of amount of waste is known | 18 | 85.7 | 3 | 14.3 |
| Medical waste storage room is available | 21 | 100.0 | 0 | 0 |
| Domestic waste storage room is available | 17 | 81.0 | 4 | 19.0 |
| Package waste storage room is available | 18 | 85.7 | 3 | 14.3 |
| Electronic waste storage room is available | 12 | 57.1 | 9 | 42.9 |
| Vegetable oil waste tank is available | 18 | 85.7 | 3 | 14.3 |
| Waste batteries storage room is available | 17 | 81.0 | 4 | 19.0 |
| The guidelines for spooling, parsing and storage are available | 21 | 100.0 | 0 | 0 |
| Internal controls are performed with waste regulations | 21 | 100.0 | 0 | 0 |
| The wastes are transported from the hospital to the recycling facility, the incineration plant or the landfill site of the private contractor | 21 | 100.0 | 0 | 0 |
| The hospital has a written protocol to reduce the volume of the production of hazardous and non-hazardous wastes | 16 | 76.2 | 5 | 23.8 |
| A guideline on the quality of health care services is followed (Ministry of Health Quality Criteria, ISO 9001, ISO 14001, Accreditation etc.) | 21 | 100.0 | 0 | 0 |
| (If any) This guide contains environmental protection | 20 | 95.2 | 1 | 4.8 |
| Responsibilities for environmental protection have been clearly defined and assigned to executive staff, medical personnel and engineers | 18 | 85.7 | 3 | 14.3 |
| There is a special staff member in the institution with responsibility for these issues (waste, hazardous chemicals, waste water, energy, pollutants, harmful emissions, radiation safety, hygiene etc.) | 18 | 85.7 | 3 | 14.3 |
| Regular training on waste management is provided | 21 | 100.0 | 0 | 0 |
| Departments that consume hazardous wastes (toxic, abrasive, flammable, carcinogenic, mutagenic, irritating, environmental damaging etc.) are defined | 19 | 90.5 | 2 | 9.5 |
| There is a program to reduce or substitute dangerous substances | 19 | 90.5 | 2 | 9.5 |
| Hazardous wastes are stored properly (containers, sealed floors, ventilation, leaking water, etc.) | 21 | 100.0 | 0 | 0 |
| Mercury-containing materials are used in our organization | 9 | 42.9 | 12 | 57.1 |
| (If used) There is work to reduce mercury-containing materials | 5 | 23.8 | 16 | 76.2 |
| Water management questions | | | | |
| Low-jump-stop luminaires are used (photocell taps, etc.) | 12 | 57,1 | 9 | 42,9 |
| Double-stage toilet reservoirs are used | 7 | 33,3 | 14 | 66,7 |
| The medical installation is regularly inspected against leaks | 21 | | | |
| There is regional flow cutting equipment (valve etc.) against water escape | 20 | 95,2 | 1 | 4,8 |
| Rain water is collected for various uses (garden irrigation, building services that do not require drinking water, etc.) | 1 | 4,8 | 20 | 95,2 |
| When the garden landscaping is decided the water requirement is taken into account | 18 | 85,7 | 3 | 14,3 |
| (If there is an automatic irrigation system) The irrigation system is automatically turned off when it rains | 5 | 23,8 | 16 | 76,2 |
| The wastewater from the dialysis area is discharged properly in accordance with the law | 13 | 61,9 | 8 | 38,1 |
| Photochemicals (fixtures, rinse water, developer, etc.) from X-ray devices are discharged under appropriate conditions | 6 | 28,6 | 15 | 71,4 |
| Chemicals (reagent residues, rinse water, etc.) coming out of the laboratory vehicles are discharged under suitable conditions | 13 | 61,9 | 8 | 38,1 |
| Energy management questions | | | | |
| There are works to reduce energy consumption | 21 | 100.0 | 0 | 0 |
| The hospital building's thermal insulation is provided | 14 | 66,7 | 7 | 33,3 |
| Refrigerants containing chlorofluorohydrocarbons that damage the ozone layer have been replaced by eco-friendly alternatives | 11 | 52,4 | 10 | 47,6 |
| Energy saving bulbs (LED etc.) are preferred in lighting | 20 | 95,2 | 1 | 4,8 |
| Care is taken to select electronic appliances from low energy consumption (class A) | 21 | 100.0 | 0 | 0 |
| Material management questions | | | | |
| Recycled materials are used in our institution (paper, plastic, etc.). | 9 | 42,9 | 12 | 57,1 |
| There is no canned food instead of fresh fruits and vegetables in our hospital dining hall | 19 | 90,5 | 2 | 9,5 |
| Frozen food is not used instead of fresh fruits and vegetables in our hospital dining hall | 19 | 90,5 | 2 | 9,5 |

| Sustainable facility management questions | | | | |
|---|---|---|---|---|
| There are enough windows to illuminate | 21 | 100.0 | 0 | 0 |
| Natural ventilation facilities are available | 21 | 100.0 | 0 | 0 |
| Outdoor recreation area for visitors and remote patients | 18 | 85,7 | 3 | 14,3 |
| Accessibility by public transport is available | 20 | 95,2 | 1 | 4,8 |
| A bicycle way and parking spaces are available | 11 | 52,4 | 10 | 47,6 |
| Car parking space is sufficient | 17 | 81,0 | 4 | 19,0 |

In Table 6, the percentages were calculated by taking the number of 'yes' answers divided by the number of questions in the section and then multiplied by 100. For instance, there were five energy management questions. If a hospital manager answered 'yes' for two questions, the percentage was calculated as (2/5) x 100 = 40. When the percentages of green initiatives were examined, it was determined that the application of waste management programs was 84% positive on average, water management was 55%, energy management was 82%, material selection was 74%, and practicing the characteristics of a sustainable facility was 86%. The total average percentage of hospitals carrying out applications was 76%.

Table 6. Compatibility percentages of hospitals according to green practices

| Hospitals | Waste management compatibility (%) | Water management compatibility (%) | Energy management compatibility (%) | Material selection compatibility (%) | Sustainable facilities compatibility (%) | Total compatibility (%) |
|---|---|---|---|---|---|---|
| A | 68.0 | 60.0 | 80.0 | 66.6 | 83.3 | 71.6 |
| B | 63.0 | 60.0 | 100.0 | 66.6 | 100.0 | 77.9 |
| C | 77.0 | 60.0 | 100.0 | 66.6 | 66.6 | 74.04 |
| D | 86.0 | 60.0 | 80.0 | 100.0 | 100.0 | 85.2 |
| E | 86.0 | 40.0 | 80.0 | 0.0 | 66.6 | 54.52 |
| F | 86.0 | 50.0 | 100.0 | 100.0 | 100.0 | 87.2 |
| G | 81.0 | 70.0 | 100.0 | 100.0 | 100.0 | 90.2 |
| H | 77.0 | 70.0 | 60.0 | 66.6 | 66.6 | 68.04 |
| I | 81.0 | 60.0 | 80.0 | 100.0 | 83.3 | 80.86 |
| J | 90.0 | 60.0 | 80.0 | 66.6 | 83.3 | 75.98 |
| K | 90.0 | 50.0 | 80.0 | 66.6 | 100.0 | 77.3 |
| L | 59.0 | 30.0 | 100.0 | 0.0 | 66.6 | 51.12 |
| M | 95.0 | 40.0 | 100.0 | 66.0 | 100.0 | 80.2 |
| N | 100.0 | 50.0 | 80.0 | 66.6 | 100.0 | 79.3 |
| O | 95.0 | 70.0 | 60.0 | 100.0 | 100.0 | 85.0 |
| P | 77.0 | 60.0 | 80.0 | 66.6 | 83.3 | 73.4 |
| R | 90.0 | 80.0 | 60.0 | 66.6 | 66.6 | 72.6 |
| S | 90.0 | 60.0 | 80.0 | 100.0 | 100.0 | 86.0 |
| $T_1$ | 100.0 | 50.0 | 80.0 | 100.0 | 66.6 | 79.3 |
| $T_2$ | 90.0 | 40.0 | 80.0 | 100.0 | 83.3 | 78.66 |
| $T_3$ | 90.0 | 40.0 | 80.0 | 100.0 | 83.3 | 78.66 |
| Mean $\overline{X}$ | 84,3 | 55,23 | 82,85 | 74,54 | 85,68 | 76,53 |

Compatibility percent = ('yes' answer/the number of question in this section)x100

## 4. Discussion

In 2017, Turkey's total GHG (greenhouse gas) emissions were 526.3 million metric tons of $CO_2$ equivalent MMTCDE. Approximately 72.2% of total greenhouse gas emissions in Turkey were caused by use of energy, 12.6% from industrial treatments, 11.9% from agricultural activities and 3.3% from wastes (TSI, 2019). Total greenhouse gas emissions in 2017 as $CO_2$ equivalent increased by 140.1% compared to 1990. Although it is not known how much hospitals contribute to these numbers, we think that it has an important portionowing to hospitals being open 24 hours a day (where heat and light energy are used continuously), with a large number of staff and patients. If hospitals with

large building areas have increased capacity to use daylight (glass curtain-wall, glass ceiling on the upper part, etc.), and recommendations (such as building a green roof) are applied to help with heat control, energy consumption will be lower. (XIAO ET AL., 2014). The hospitals included in this research do not have green roofs, or glass curtain-walls. It is assumed that energy consumption is high for these reasons. For heating, the hospital with the largest indoor space consumes 1,190,000 $m^3$ of natural gas, 9,109,000 kW of electricity and 175,000 $m^3$ of water annually. It is appropriate to have green spaces for a building to be a sustainable facility; however, at this point, water management needs to be well planned. (BERNDTSSON, 2010). In this study, the hospital with the largest green space consumes 79,188 $m^3$ of water. For this reason, hospitals should develop a strategy which decreases their carbon footprint in energy and water consumption. A more responsible behaviour for energy and water consumption by nurses in their practice may also work. Additionally, the age of the building is a factor which affects the hospital's service capacity (the number of outpatients and inpatients, etc.) in terms of environmental management (GREENER HOSPITALS, 2005). In this study, the average building age is 19 years, the average annual number of out-patients is 263,800, the average number of inpatients is 8352, and the average number of operations is 6006. Considering that hospitals have more polluting features than other buildings of a similar size, they should be evaluated in terms of lighting and energy and water consumption during the design process, and these facilities should be built accordingly. The lack of shuttle buses for hospital staff and the fact that most patients prefer to come to the hospital in their own car adds to the overall carbon footprint.

Although the hospitals included in the study claimed that they carry out good practices, in waste management especially, the fact that the medical waste per bed was found to be excessive in some of the hospitals suggests that something needs improving. For example, hospital 'O' suggested that it meets 95% of the criteria; however, its medical waste per bed is more than all the other hospitals (4.09 kg). It was followed by hospital 'J', which produces 1.85 kg of medical waste per bed and claimed that it meets 90% of the criteria. Most of the products used by health institutions eventually become waste. Approximately 80% of hospital waste is considered to be general and irregular waste, and medical waste and hazardous chemicals constitute the rest (WHO, 2009). In Turkey, according to the Turkey general directorate of public hospitals (TGDPH) medical waste report public hospitals produced 5.03 kg of medical waste per patient in 2014. Considering the number of the patients to whom some hospitals in the city provide services, it can be stated that they generate an excessive amount of waste. In Turkey, every hospital has general procedures, yet they have difficulty following these procedures. The study carried out by ANANTH ET AL. (2010) stated that it is of vital importance that personnel are aware of which kind of waste should be sorted under which waste category. The reason for the excessive quantity of waste, even though the personnel have been trained, might be that some wastes have been thrown into medical waste bags even if they were not medical waste.

The percentages for green practice acheivements in the hospitals show that the lowest recorded was for water and materials management. The reason for the low water management score might be due to a lack of awareness of the subject during the construction of the hospital building and also that the importance of hospital architecture might have been recognized too late in the country. In big hospitals in the United States, 133 billion gallons of water were consumed in 2007, and a total of $615 million were spent (U.S. ENERGY INFORMATION ADMINISTRATION, 2012). Also, the areas in the hospitals in which water usage is the highest are the interior areas, such as restrooms or the sections where heating/cooling and medical equipment are located (MWRA, 2012). In Turkey, no data has been found regarding these aspects; however, it is assumed that water consumption is higher. Yet, by using new water technologies, hospitals can provide environmental, financial and clinical benefits, such as more successful infection prevention from taps which reduce water splash in hand-wash stations (HEALTH RESEARCH & EDUCATIONAL TRUST, 2014).

Hospitals can also improve their materials management with regard to food choices. Frozen foods have a greater environmental footprint than fresh foods since the storage of frozen foods requires more energy. On the other hand, frozen foods do not contain artificial preservatives, and they can be frozen when they have the highest quality of freshness and nutritional value during the harvest season. Hospitals should reduce their environmental footprint by improving the balance between frozen and fresh foods while providing a balanced menu for hospital staff and patients (HEALTH RESEARCH & EDUCATIONAL TRUST, 2014). The reason for the low material selection score found in this study is thought to be related to the high cost of recycling. Outsourcing of

catering in hospitals can also lead to the use of frozen or canned foods.

Based on the information provided via the Green Practices Assessment Form (developed by researchers), the average general conformity of the hospitals investigated in this study was 73.03%. Public hospitals in cities are thought to have a reasonable status regarding green practices, and by implementing specific measures this percentage can be increased. Moreover, the hospitals in Turkey should be invest in social responsibility awareness, and environmental protection practices should be instigated.

## 5. Conclusion and suggestions

This study aimed to draw attention to the importance of health institutions being climate-friendly, and reducing costs, increasing effectiveness, productivity and providing high quality services. Hospital management, who are in charge of public, private and medical faculty hospitals, are encouraged to apply environmentally friendly green strategies in the interest of developing and improving sustainable systems, to adopt environmentally friendly approaches to health care practices within the framework of social responsibility and to use healthy and environmentally sustainable energy resources, which are important expense items in the field of health care (e.g., sun, wind, or geo-thermal energy). It is also suggested that energy efficient practices have been popularized, especially in hospitals, and awareness should be raised among hospital staff, patients and their families and society as a whole regarding their implementation.

In order to ensure that in the future people can live a comfortable life in a healthy environment, the "green" concept should be taken into consideration during the building and implementation processes of hospital construction. Accordingly, government leaders should give priority to environmental health care as a strategic obligation. For this purpose, the use of hazardous chemicals should be reduced, or replaced, with healthier alternatives. Waste disposal should be performed under safe conditions, clean and sustainable new generation energy resources should be used, water consumption should be reduced, new transportation methods should be developed for patients and staff. Production and consumption of healthy foods should be encouraged, drug utilization should be well-managed and drugs disposed of safely. Hospital buildings should be designed to be green and healthy, and products and materials should be purchased under safer and more sustainable conditions.

## References


Ananth A.P., Prashanthini V., Visvanathan C. 2010. Healthcare waste management in Asia. *Waste Managament*, 30: 154–161.

Berndtsson J.C. 2010. Green roof performance towards management of run off water quantity and quality: A review. *Ecological Engineering*, 36, 4: 351–360.

Economidou M. et al. 2011. *Europe's buildings under the microscope – A country-by-country review of the energy performance of buildings*. BPIE, Brussels.

*Greener Hospitals, Improving Environmental Performance*. 2005. Environment Science Center. Wissenschaftszentrum Umwelt, Bristol-Myers Squibb, Augsburg.

GGHH - Global green and healthy hospitals. 2014. *Annual Progress Report*. Global Green and Healthy Hospotals, Health Care Without Harm.

Goodman B. 2013. Role of the nurse in addressing the health effects of climate change. *Nursing Standard*, 27, 35: 49–56.

Green Guide For Health Care. 2007. *The Green Guide for Health Care Version 2.2*, GGHC.

Health Research & Educational Trust. 2014. *Environmental sustainability in hospitals: The value of efficiency*. Health Research & Educational Trust, Chicago, IL.

Hernandez A.-C.G. 2016. *Reducing healthcare's climate footprint opportunities for European hospitals & health systems*. HCWH Europe, Brussels.

International Council of Nurses. 2018. *Nurses, Climate Change and Health*, Geneva.

MWRA - Massachusetts Water Resources Authority. 2012. *Water use case study: norwood hospital*. http://www.mwra.state.ma.us/04water/html/bullet1.htm

Neira M., Bertolini R., Campbell-Lendrum D., Heymann D.L. 2008. The year 2008: a breakthrough year for health protection from climate change? *American Journal of Preventive Medicine*, 35, 5: 424–425.

Palteki A.S. 2013. *The Assessment of the Government Hospitals in Istanbul According to Green Hospital Standarts*. İstanbul University, Institute of Health Science, Public Health, Istanbul (Master's Thesis)

Pinzone M., Lettieri E., Masella C. 2012. Sustainability in Healthcare: Combining Organizational and Architectural Levers. *International Journal of Engineering Business Management*, 4, 38: 1–9.

Prüss-Ustün A., Wolf J., Corvalan C., Neira M. 2016. *Preventing disease through healthy environment: A global assessment of the burden of disease from environmental risks*. World Health Organization, Geneva.

Sahamir S.R, Zakaria Z. 2014. Green Assessment Criteria for Public Hospital Building Development in Malaysia. *Procedia Environment Science*, 20: 106–115.

Turkey General Directorate of Public Hospitals [TGDPH]. 2015. *Medical waste report*, (Accessed 19 August 2019).

TSI - Turkey Statistic Institute. 2018. *Medical waste report* (Accessed 19 August 2019).

TSI - Turkey Statistic Institute. 2019. *Greenhouse emission statistics repor*t, (Accessed 21 August 2019).

U.S. Department of Energy. 2009. *Department of Energy announces the launch of the Hospital Energy Alliance to increase energy efficiency in the healthcare sector*. https://www.energy.gov/articles/department-energy-announces-launch-hospital-energy-alliance-increase-energy-efficiency (Accessed 19 November 2019).

U.S. Energy Information Administration. 2012. *Large hospital stend to be energy-intensive.* https://www.eia.gov/todayinenergy/detail.php?id=7670 (Accessed 19 November 2019).

WHO. 2009. *Healthy hospitals healthy planet healthy people: Addressing climate change in health care settings, Climate footprint report*, WHO, Health Care Without Harm.
WHO. 2017. *Climate change and health fact sheet*.
Xiao M., Linc Y., Hane J., Zhang G. 2014. A review of green roof research and development in China. *Renewable and Sustainable Energy Reviews*, 40: 633–648.