

The Medical waste Inventory Analysis of the Eastern Black Sea Region: The Case of Artvin Province

*KazımOnur Demirarslan¹, Serden Basak²

¹Artvin Coruh University, Faculty of Engineering, Environmental Engineering Department, Turkey

²Artvin Coruh University, Faculty of Health Sciences, Occupational Health and Safety Department, Turkey

Corresponding Author:KazımOnurDemirarslan

Abstract: The medical facilities have initiated the development of healthy societies. Diseases that may have been called dangerous in the past have now not being feared and become easily treatable diseases. The development of medicine has also increased the amount, variety, and harm of medical wastes. Medical wastes, which are not properly managed, cause harm to the environment and human health. The medical waste management in Turkey as well as in the world is becoming a more and more remarkable subject. In this study, the medical waste inventory was created in a very difficult area in terms of topography. Artvin was selected as the study area in the region, and it was desired to represent a province which differs from the other provinces in terms of population and geography. The data used in the study were obtained from the healthcare institutions in Artvin with the help of a questionnaire. According to this, it was determined that the mean amount of medical waste in the study area was 0.707 kg/bed/day. With this study, the medical waste inventory of a city has been created and thus, it is aimed to represent a resource for future studies.

Keywords: Artvin, East BlackSea Region, Medical Wastes

Date of Submission: 11-09-2017

Date of acceptance: 20-09-2017

I. Introduction

Urbanization and population have increased with industrial and economic developments, and accordingly, the developments in the fields of medicine and health have also accelerated and increased. In the face of these developments, the medical sector serves the community health with its various branches [1,2,3]. As a result of this service, medical wastes ensue. The problem of the medical waste increases with the rapidly increasing population and urbanization [4]. Medical wastes are solid and/or semi-solid wastes that humans and animals produce in treatment, research, and care periods, clinical diagnosis, and pathological tests by hospitals, other healthcare institutions, diagnostic centres, research laboratories, and community health centres [5,6,7]. The World Health Organization (WHO) defines the wastes that comprise of health-care-research activities, which include a wide range of used needles, syringes, contaminated clothing, body and tissue parts, diagnostic specimens, blood and blood products, chemicals, pharmaceuticals, medical devices, and radioactive substances, as medical wastes [8]. In many countries in the world, medical wastes are qualified to be very dangerous and lethal due to the infectious agents, chemical and radioactive substances they contain [9]. These medical wastes in question lead to direct and/or indirect problems due to inadequate management techniques and may include potential agents that will affect the community and employee health. Although they are small in quantity compared to other wastes, their properties make these wastes more dangerous than other wastes [10,11]. Every institution that produces medical wastes has to manage these wastes separately from other wastes due to the agents they contain that are harmful to human and environmental health. In the contrary case, these wastes cause diseases such as typhoid fever, cholera, hepatitis, AIDS, diarrhoea, SARS, spirochete, and also cause the growth of agents such as effluvia, insects, flies, and rodents [12,13]. Many developed countries have introduced very strict regulations and laws about the management and disposal of medical wastes. For example, high awareness in the EU Member States and strict regulations trigger the development of technologies for the appropriate disposal of medical wastes [6]. A large amount of medical waste is produced daily from all the hospitals in the world, and the composition of medical wastes varies by the branches and types of the medicine and properties of healthcare institutions [10,14]. The disposal of these wastes is an important event fed by the increasing environmental awareness, social authorities, lack of knowledge about the alternative disposal methods, strict sanctions of laws and regulations, and decreasing storage capacities [15].

In this study, the amount of medical wastes produced in the healthcare institutions in Artvin province in the Eastern Black Sea Region of Turkey was examined. Furthermore, it was also investigated how the household wastes, recyclable wastes, and batteries in each healthcare institution in the province are collected. This study is important in terms of revealing the importance Turkey gives to medical wastes produced in the

health sector. 209,648 beds and affiliated 30,449 healthcare institutions were reported in Turkey in 2015. Due to the ever-increasing bed capacities and healthcare institutions in all provinces, it is more important to carry out studies on the medical waste. For example, one of the most striking examples of medical wastes in Turkey is in Zonguldak province. Medical wastes have been left to the coastline of Kozluk district of Zonguldak province for more than 20 years, and these wastes threaten the environment and public health [11]. For this reason, especially in the provinces with different topographies as Artvin, the subject of medical waste is a subject that should be examined even more.

II. Material And Method

Artvin province is a province that is located in the northeast of Turkey and has a border with the Republic of Georgia. The settlement opportunities are very limited in the province, which has different elevations in terms of the topography. In addition to these negativities in urbanization, services such as health and municipality may be limited compared to other provinces within opportunities. The province is composed of 8 districts, and all the districts have state hospitals. When the district and province total population is examined, it is observed that Ardanuç had a population of 10,744 people, Arhavi had 20,533, Borçka had 22,036, Hopa had 35,406, ArtvinMerkez (Centre) had 34,626, Murgul had 6,987, Şavşat had 17,144, and Yusufeli had 20,592 people, and the total population was 168068 in 2016. There are currently 7 state hospitals and 1 district hospital in the province, as well as 1 Oral and Dental Health Centre, 8 Community Health Centres, and 8 Family Health Centres. The map showing the study area is presented in Figure 1.



Fig. 1. Study Area

In this study, all healthcare institutions in the province were visited, and the waste amounts of the institutions were determined with the questionnaire study. The questionnaire study was conducted, after obtaining the necessary permits, on the staff that works in healthcare institutions and is responsible for wastes. The total number of employees in the institution, the number of patients coming to the hospital, the number of beds, the amount of medical waste, whether the medical wastes are collected in a special place, who collects the medical waste, what happens to the household wastes, the presence of recycling boxes in the institution, the presence of the personnel responsible for medical wastes, and whether they are educated on this subject are questioned in the questionnaire. As a result of the data obtained, the amount of medical waste was related to the number of patients. Furthermore, these amounts were compared to the data obtained in the studies conducted in Turkey and in the world.

III. Results

The composition, ratio, and formation of medical wastes can vary by many factors such as population, the size and properties of healthcare institutions, the number of beds and clinics of hospitals, and the most current unit used to express the medical waste ratios is mass per bed or day [11,14,16]. In this study, the amounts of medical wastes produced are studied as day/mass. The reason for this is that the amounts of medical waste in units, in which both in-patient and out-patient treatment is performed, are added in the study area.

3.1. Medical Waste Data of Artvin City Centre

Artvin city centre is the most crowded area as the population in the study area, and it includes a state hospital, an Oral and Dental Health Centre, 2 Family Health Centres, a Community Health Centre and a Public Health Centre. Artvin State Hospital was established in 1945, and it is the only hospital in the centre. In order to increase the capacity, an additional building with 120 beds was constructed and put into operation in 2006. Then, a new additional building was needed and a second additional building with a total of 11 floors and a

capacity of 70 beds, including 7 private rooms, 21 semi-private rooms, Level II intensive care unit with 15 beds, Level I neonatal intensive care unit with 4 beds, a Level II emergency service, a cafeteria, a boiler room, services, polyclinics, a conference room, and an administrative division was constructed [17].

The information about the waste management of Artvin State Hospital, Oral and Dental Health Centre, and 2 family health centres is presented in Table 1. Since potential medical wastes produced at the Community Health Centre and Public Health Centre are collected within the hospital, they are not included in the table.

Table 1. The medical waste amounts of health facilities in Artvin city center

Health facilities	Incoming patient number (people/day)	Medical Waste Amount(kg/day)	Medical Waste Collecting Frequency
Artvin state hospital	1400	150	7 days
Artvin oral and dental health center	167	10.7	7 days
Primary care clinic No.1*	-	-	-
Primary care clinic No.2	20	0.136	Once in a month
Total	1587	160.8	

* In the questionnaire study, it was learned that the medical wastes produced here were given to Artvin State Hospital without being weighed.

As can be understood from Table 1, a total of 160.8 kg/day of medical waste is produced in Artvin city centre, and this figure is equal to 0.101 kg/patient/day when proportioned to the number of patients. Since there is no medical waste disposal institution in Artvin province, the medical wastes in the healthcare institutions in question are stored in a special place and given to the authorized disposal company. When other wastes apart from medical wastes were examined, it was determined that household wastes are not specially separated in Artvin State Hospital and only batteries are collected in the institution in terms of recycling. It is understood that at the Oral and Dental Health Centre, household wastes are collected privately and received by the municipality, and glasses and batteries are collected as recyclable waste in the institution. It is understood that in the family health centre number 2, household wastes are collected privately, and plastic and paper are being separated as a recycling work. It is stated that all of these institutions have responsible staff dealing with medical wastes, but it is stated that only the medical waste staff in the family health centre number 2 does not receive education on this subject.

3.2. Medical Waste Data of Ardanuç District

There is one district integrated hospital in the district. The medical waste information of the hospital is presented in Table 2 as a total.

Table 2. The medical waste amounts of health facilities in Ardanuç district

Health facilities	Incoming patient number (people/day)	Medical Waste Amount(kg/day)	Medical Waste Collecting Frequency
Ardanuç district hospital	100	3	15 days

As can be seen from Table 2, 3 kg/day of medical waste is produced in Ardanuç district, and when this figure is proportioned to the number of patients, it is observed that there is a medical waste of 0.03 kg/patient. In these institutions, medical wastes are collected in special places and taken by an authorized company every 15 days. Household wastes are privately collected and disposed of by the municipality. It was determined that no study had been conducted on recycling in these institutions.

3.3. Medical Waste Data of Arhavi District

There are one state hospital and one family health centre within the district boundaries. Arhavi State Hospital that comprises of 3 buildings has a capacity of 64 beds and includes 2 operating rooms, 10 intensive care units, and 2 delivery rooms. It was determined that medical wastes are collected in a special place in the hospital and taken by an authorized company, and it is also understood that household wastes are collected separately at the source and disposed of through the municipality. It was observed that paper and battery wastes are also collected in the institution. In the family health centre, medical wastes are collected in special places and taken by an authorized company again. Furthermore, household wastes are collected separately and disposed of by the municipality. However, there are no studies on recyclable wastes. The amounts of medical waste and the number of patients per day in Arhavi State Hospital and the family health centre are presented in Table 3.

Table 3. The medical waste amounts of health facilities in Arhavi district

Health facilities	Incoming patient number (people/day)	Medical Waste Amount(kg/day)	Medical Waste Collecting Frequency
-------------------	--------------------------------------	------------------------------	------------------------------------

			Frequency
Arhavi state hospital	354	25.47	7 days
Arhavi primary care clinic	300	0.158	15 days
Total	654	25.628	

When Table 3 is examined, it is observed that 25.47 kg/day of medical waste is produced in Arhavi State Hospital and when it is proportioned to the patients coming to the hospital, it becomes 0.071 kg/patient. When the family health centre is examined, it is observed that this figure is 0.00052 kg/patient.

3.4. Medical Waste Data of Borçka District

In 1989, it started to serve as SSK regional hospital with an 110-bed capacity. Since 2005, it has been serving as Borçka state hospital with 130 beds for 22 years. The amount of medical waste and the number of patients in this hospital are presented in Table 4.

Table 4. The medical waste amounts of health facilities in Borçka district

Health facilities	Incoming patient number (people/day)	Medical Waste Amount(kg/day)	Medical Waste Collecting Frequency
Borçka state hospital	250	12	7 days

The amount of medical waste produced in Borçka district was determined to be 12 kg/day (0.048 kg/patient/day). Medical wastes are privately collected in the hospital and are taken by an authorized disposal company once a week. Household wastes are not collected in a special place in the hospital. However, there is a collection box for battery wastes in the hospital. Furthermore, there is personnel dealing with medical wastes in the institution, and it is stated by the hospital that they are educated.

3.5. Medical Waste Data of Hopa District

Hopa district of Artvin province is a settlement built on the coast of the Black Sea and is the most crowded district in terms of population. The district also has a border with the Republic of Georgia. Moreover, the port on the border of the district and the campus of ArtvinÇoruh University show a significant increase in population. For this reason, there are one state hospital, five family health centres, one community health centre, and one emergency health service station in the district. The daily number of patients in these institutions and the amounts of medical waste produced in these areas are presented in Table 5.

Table 5. The medical waste amounts of health facilities in Hopa district

Health facilities	Incoming patient number (people/day)	Medical Waste Amount(kg/day)	Medical Waste Collecting Frequency
Hopa state hospital	566	19	7 days
Primary care clinic No.1	-	3	Once in a month
Primary care clinic No.2	167	0.24	Every 3 months
Primary care clinic No.3	-	-	-
Family practice center No.3	150	0.136	Every 2 months
Kemalpaşa Family practice center	-	0.098	Once in a month
Community health care center	-	0.0277	Every 6 months
Emergency health facilities	-	-	-
Total	883	22.5	

When Table 5 is examined, it is observed that a total of 22.5 kg of medical waste is produced by daily 883 patients in Hopa district. When proportioned to the number of patients, 0.025 kg/patient is calculated. Medical wastes are collected in special places in all institutions, and medical wastes produced in all healthcare institutions except for 2 institutions are given to a licensed company. However, the medical wastes produced in the 2 institutions in question are sent to Hopa State Hospital. When recyclable wastes were examined, it was determined that studies are conducted in only four institutions. It was understood that in these institutions, plastic, metal, and paper are collected separately and that there are different boxes for batteries.

3.6. Medical Waste Data of Murgul District

Murgul District is surrounded by Artvin City Centre in the east, Arhavi District in the west, Borçka District in the north, and Yusufeli District in the south. There is one district hospital in the district. The patient and medical waste records of this hospital are presented in Table 6.

Table 6. The medical waste amounts of health facilities in Murgul district

Health facilities	Incoming patient number (people/day)	Medical Waste Amount(kg/day)	Medical Waste Collecting Frequency
Murgul district hospital	57	2.46	15 days

It can be observed that the medical wastes produced in the hospital are 0.043 kg/patient when proportioned to the patients. Although the district and the hospital are small, they are very sensitive in terms of medical wastes. Medical wastes produced in the hospital are stored in special places by trained personnel and given to an authorized company every fifteen days. Furthermore, recyclable wastes such as paper are collected separately at the source.

3.7. Medical Waste Data of Şavşat District

The district is surrounded by Ardahan city centre and Hanak district in the east, Posof district in the north east, Ardanuç in the south and south west, ArtvinMerkez (Centre) and Borçka district in the west, and the Georgia State in the north. There are one state hospital and one community health centre in the district. The data obtained from these institutions are presented in Table 7.

Table 7. The medical waste amounts of health facilities in Şavşat district

Health facilities	Incoming patient number (people/day)	Medical Waste Amount(kg/day)	Medical Waste Collecting Frequency
Şavşat state hospital	191	18	15 days
Community health care center	10	-	-
Total	201	18	

When the medical wastes produced in the hospital in the province are proportioned per patient, the result is found to be 0.094 kg/person. Wastes that are collected by the personnel, who are trained on medical wastes at the hospital, are stored in a special place and then collected by a licensed company twice a month. It was also understood that household wastes are collected separately at the source and taken by the district municipality.

3.8. Medical Waste Data of Yusufeli District

There is one state hospital in the district, and the data on here are presented in Table 8.

Table 8. The medical waste amounts of health facilities in Yusufeli district

Health facilities	Incoming patient number (people/day)	Medical Waste Amount(kg/day)	Medical Waste Collecting Frequency
Yusufeli state hospital	166	11.15	15 days

Medical wastes produced in the district hospital can be said to be 0.067 kg/patient. Medical wastes produced are collected in special places by the trained personnel and given to a licensed firm. Household wastes are collected separately and taken by the municipality. However, no study has been conducted on recyclables in the hospital.

3.9. General Medical Waste Data of Artvin

Medical wastes produced in Artvin province are collected by a licensed company in Trabzon province, which is approximately at 250 km distance, and are steam sterilized at the 8 ton/day capacity facility and then sent to the regular storage area. Nearly all of the medical wastes in the province are produced in the state hospitals. It is stated that until the beginning of 2012, some of the hospitals in the province used to give their medical wastes to this licensed company and some of them used to perform burning or storing procedures unrestrainedly. However, since the end of 2012, all the wastes produced have been given to the licensed company and disposed of. The transportation and disposal of the medical wastes produced are performed at the price determined by the Provincial Environmental Directorate. Medical wastes produced in the districts and transportation and disposal costs by years are presented in Figures 2. Population changes between the years of 2013-2016 of the districts, the effect of them on the amounts of medical waste, and the relationship between the

price paid for transportation and disposal were analysed by two-way ANOVA. ANOVA is a statistical-based analysis method that reveals and identifies the relationships between three or more independent variables to be analysed [18,19]. The two-way ANOVA analysis is used to compare the effects between more than one variable. In this study, the significance level was determined to be 0.05. This level is widely used in similar statistical analyses [20,21]. The obtained values are presented in Table 9.



Fig. 2. According to Artvin centers and provinces for years medical waste changes and waste transportation and disposal expenditures [22,23,24,25]

When the amount of medical waste in the study area in Figure 2 is examined, it is observed that medical wastes in the central district are considerably higher than those of the other districts. The reason for this is that the hospital in the central district is larger and more comprehensive than the hospitals in the other districts. Due to the hospital's being comprehensive, people living in the districts of Artvin province prefer to come to the hospital at the centre for any significant health problems.

Table 9. The relationship between the population and amount of medical waste and transportation and disposal expenditure in the study area by years

District	P-Value
Centre	0,00014
Ardanuç	0,00086
Arhavi	0,00029
Borçka	1,2E-6
Hopa	7,2E-5
Murgul	7,5E-6
Şavşat	0,00031
Yusufeli	2,1E-6

According to this analysis, since the p-value for the population, the amount of waste, and transportation-disposal expenditures is less than the critical value of 0.05 in the entire study area, a significant difference was found at 95% significance level among the population, the amount of waste, and transportation-disposal expenditures. Accordingly, the population mobility in the study area has an important effect on the amount of medical waste and on the expenditures for the transportation and disposal of these wastes.

IV. Discussion

Medical wastes constitute an important part of the wastes produced in Turkey, and as a result, efficient management and control systems should be applied to special regulations. As a candidate country, Turkey adopts the European Union Environmental Directives to its laws and regulations. For this reason, a regulation on medical wastes was published by the Ministry of Environment and Forestry in 1993, and it was amended in 2005 [16,26]. Then, it was reorganized and entered into force by the Ministry of Environment and Urbanization in 2017. The aim of this Regulation is to prevent the delivery of medical wastes, from their production to disposal, to the receiving environment, directly or indirectly, by harming the environment and human health. Furthermore, its aim is to regulate procedures and principles for determining and applying principles, policies and programs, as well as legal, administrative, and technical principles for collecting medical wastes separately at the source without harming the environment and human health, transporting them within the healthcare institution, temporarily storing them, transporting them to the medical waste processing institution, and

disposing them [27]. The regulation also mentioned medical waste producers. According to this, primary healthcare institutions such as university hospitals and clinics, general-purpose hospitals and clinics, maternity hospitals and clinics, military hospitals and clinics, community health centres, family health centres, dispensaries, etc., other health centres, medical centres, centres providing outpatient diagnosis and treatment services, dialysis centres, mortuary and autopsy centres, medical and biomedical laboratories, biotechnology laboratories and institutes, microbiology laboratories, medical research centres, blood banks and transfusion centres, emergency and first aid centres, ambulance services, rehabilitation centres, other healthcare institutions providing health services (physicians' offices, dental and oral health offices, etc.), nursing homes and retirement homes, animal hospitals, institutions performing experiments and research on animals, veterinary control and research institutes, veterinary clinics and offices, zoos, acupuncture centres, home treatment and nursing services, beauty, ear piercing, and tattoo centres, pharmacies, institutions and organizations producing medical wastes as a result of their activities are stated to be medical waste producers. Furthermore, these institutions and organizations are obliged to make protocols with the municipality they are affiliated to for the collection, transportation, and disposal of the medical wastes produced. Moreover, if the organization in question produces more than 50 kilograms of medical waste per day, it must establish temporary medical waste storage. In the case of producing medical wastes up to 50 kilograms per day, it must have a temporary medical waste container. In the case of producing medical wastes up to 1 kilogram per day, it must take the medical wastes to the nearest or most appropriate temporary medical waste storage/container or give these wastes to the medical waste collection vehicle. Furthermore, according to this regulation, plastic red bags, which are tear, puncture, explosion, and transportation-resistant, produced to be impermeable, double-stitched, and without bellows from a medium-density polyethylene raw material, with a double layer thickness of 100 microns, with a lifting capacity of at least 10 kilograms, with the black "International Biohazard" emblem and "ATTENTION! MEDICAL WASTE" expression on both sides in a size than can be seen, must be used in the collection of medical wastes. Pathological wastes must be collected separately from other medical wastes in plastic red storage boxes, which are puncture, breakage, and explosion-resistant, waterproof and impermeable, with a black "International Biohazard" emblem and black "ATTENTION! PATHOLOGICAL MEDICAL WASTE" expression on it. The wastes with cutting and penetrating properties must be collected separately from other medical wastes in plastic boxes or containers, which are puncture, tear, breakage, and explosion-resistant, waterproof and impermeable, not possible to be opened and poked, with a black "International Biohazard" emblem and black "ATTENTION! SHARPS COLLECTION CONTAINER" expression on it or in laminated cardboards or containers with the same characteristics [27].

The amount of the medical waste produced in the study area was compared with the amount of the medical waste in other provinces in Turkey and the examples in the world. While making a comparison, kg/bed/day data of the medical wastes, which were obtained by using the number of beds determined by the Ministry of Health Public Hospitals Administration of Turkey in 2017, were used. According to these data, the amounts of medical wastes in Artvin province are presented in Table 10 (Artvin province environmental status reports).

Table 10. Amount of medical waste in the study area according to years [22,23,24,25]

Year	kg/bed/day
2013	0.604846
2014	0.680679
2015	0.722029
2016	0.821704
Average	0.707314

Accordingly, an average of 0.707 kg/bed/day of medical waste is produced in the study area. This amount was compared with the amounts of waste in other countries in the world, and Table 11 was obtained.

Table 11. Comparison of the amount of medical waste in the study area with the amounts in the world

Country	Amount (kg/bed/day)	Reference
USA	0.25~7	[14]
Japan, Turkey, Canada, India, Thailand, Bangladesh	0.11~3.9	

Jordan	1.88~6.10	
Tanzania	0.84~5.8	[8]
Korea	0.14~0.49	
Greece	0.58~1.4	
Portugal	2.5~4.5	[26]
Italy	3~5	
Croatia	1.2	[27]
Ethiopia	0.361~0.669	[28]
Norway	3.9	[29]
Spain	4.4	
UK and France	3.3	
Latvia	1.182	[30]
Kazakhstan	5.34	
Brasil	3.2	[31]
Iran	3.5~4.5	

As a result of the literature review conducted in the study, it was found according to the data of 2014 that the number of healthcare institutions affiliated with the Public Hospitals Administration of Turkey is 874 and the amount of medical waste collected is 37992 tons/year. While the Average Medical Waste Amount Per Polyclinic is 0.13 kg/person, the Average Medical Waste Amount Per Inpatient is stated to be 5.03 kg/bed/day. Again, the first 30 cities producing the most medical waste in Turkey are given in Table 12 [32]. Within the context of this study, a total of 85963 kg of medical waste was produced in Artvin province in general in 2014 [24].

Table 12. The comparison of the most medical waste and quantities producing cities in Turkey and Artvin [24,32].

City	Amount (kg)	City	Amount (kg)
İstanbul	6,826,997	Aydın	557,372
Ankara	4,182,621	Van	556,680
Izmir	2,547,834	Sakarya	524,736
Bursa	1,153,315	Erzurum	521,858
Adana	1,038,771	Balıkesir	447,777
Konya	826,468	Denizli	446,692
Diyarbakır	781,171	Zonguldak	441,603
Antalya	727,214	Kayseri	428,908
Mersin	669,401	Ordu	417,854
Trabzon	669,132	Muğla	363,263
Samsun	668,967	Çorum	348,596
Gaziantep	650,254	Kahramanmaraş	342,562
Şanlıurfa	646,501	Tokat	331,548
Kocaeli	622,313	Eskişehir	328,272
Manisa	606,328	Artvin	85,963
Hatay	572,755		

Since medical wastes threaten the environment and public health, it is inconvenient for them to be mixed with household wastes without being subjected to the necessary procedures. The risk has been minimized thanks to the legal regulations that are in force and tightly controlled in Turkey. However, there may be extra financial burdens of hospitals such as the establishment of air-conditioned and leak-proof areas to store medical wastes for a certain period of time if there is no disposal facility in their city, and the purchase of this service. When it comes to human and environment health, it is a necessity to meet these financial burdens.

Acknowledgments

We would like to thank all the institutions and organizations that have helped in this study, as well as messrs.Elifşik and MukaddesDağ.

References

- [1]. Magdy M, El-Salam A. Hospital waste management in El-Beheira governorate Egypt. *Journal of Environmental Management*. 2002; 91:618-629.
- [2]. Jahandideh S. Jahandideh S. Asadabad EB. Arkarian M. Mohavedi MM. Hosseini S. Jahandidah M. The use of artificial neural networks and multiple linear regression to predict rateof medical waste generation. *Waste Management*. 2009; 29(11):2874-2879.

- [3]. Insa E, Zamorano M, Lopez R. Critical review of medical waste legislation in Spain, resources. *Conservation and Recycling*. 2010; 54(12):1048-1059
- [4]. Makajic ND, Petrovic N, Belic A, Rokvic M, Radakovic JA, Tubic V. The fault tree analysis of infectious medical waste management. *Journal of Cleaner Production*. 2016; 113:365-373. [5] Askarian M, Heidarpour P, Assadian O. A total quality management approach to healthcare waste management in Namazi Hospital, Iran. *Waste Management*. 2010; 30(11):2321-2326.
- [5]. Bujak JW. Heat recovery from thermal treatment of medical waste. *Energy*. 2015; 90:1721-1732.
- [6]. Graikos A, Voudria E, Papazachariou A, Losifidis N, Kalpakidou M. Composition and production rate of medical waste from a small producer in Greece. *Waste Management*. 2010; 30(8-9):1683-1689.
- [7]. Komilis D, Fouki A, Papadopoulos D. Hazardous medical waste generation rates of different categories of health-care facilities. *Waste Management*. 2012; 32(7):1434-1441.
- [8]. Ma H, Cao Y, Lu X, Ding Z, Zhou W. Review of typical municipal solid waste disposal status and energy technology. *Energy Procedia*. 2016; 589-594.
- [9]. Bokhoree C, Beeharry Y, Soomary N. Assessment of environmental and health risks associated with the management of medical waste in Mauritius. *APCBEE Procedia*. 2014; 9:36
- [10]. Çalış S, Arkan B. The views of the nursing students about the medical wastes and their effects on the environmental and human health. *Procedia-Social and Behavioral Sciences*. 2014; 116:1472-1476.
- [11]. Abdulla F, Qdais HA, Rabi A. Site investigation on medical waste management practices in Northern Jordan. *Waste Management*. 2008; 28(2):450-458.
- [12]. Deng N, Yu-Feng Z, Yan W. Thermogravimetric analysis and kinetic study on pyrolysis of representative medical waste composition. *Waste Management*. 2008; 28(9):1572-1580
- [13]. Chang YW, Li KC, Sung FC. Medical waste generation in selected clinical facilities in Taiwan. *Waste Management*. 2010; 30(8-9):1690-1695.
- [14]. Goldberg ME, Vekeman D, Torjman MC, Seltzer JL, Kynes T. Medical waste in the environment: do anesthesia personnel have a role to play? *Journal of Clinical Anesthesia*, 1996; 8(6): 475-479.
- [15]. Birpınar ME, Bilgili MS, Erdoğan T. Medical waste management in Turkey: A case study of Istanbul. *Waste Manag*. 2009; 29(1): 445-448.
- [16]. T. C. Ministry of Health, Turkish public hospitals institution, General secretary of the Union of Public Hospitals of Artvin, Artvin state hospital [internet], Turkey, [cited 23 July 2017]. Available from: <http://www.artvinhd.saglik.gov.tr>.
- [17]. Gumus K, Selbesoglu MO, Celik CT. Accuracy investigation of height obtained from Classical and Network RTK with ANOVA test. *Measurement: Journal of the International Measurement Confederation*. 2016; 90:135-143.
- [18]. Bilga PS, Singh S, Kumar R. Optimization of energy consumption response parameters for turning operation using Taguchi method. *Journal of Cleaner Production*. 2016; 137:1406-1417.
- [19]. Zhang JT. An approximate degrees of freedom test for heteroscedastic two-way ANOVA. *Journal of Statistical Planning and Inference*. 2012; 142(1): 336-346.
- [20]. Zhou H, Meng A, Long Y, Li Q, Zhang Y. Classification and comparison of municipal solid waste based on thermochemical characteristics. *Journal of the Air & Waste Management Association*. 2014; 64(5):597-616.
- [21]. Artvin Province 2013 Yearly Environmental Status Report, Artvin Provincial Directorate of Environment and Urbanism EIA and Environment Services Directorate, 2014.
- [22]. Artvin Province 2014 Yearly Environmental Status Report, Artvin Provincial Directorate of Environment and Urbanism EIA and Environment Services Directorate, 2015.
- [23]. Artvin Province 2015 Yearly Environmental Status Report, Artvin Provincial Directorate of Environment and Urbanism EIA and Environment Services Directorate, 2016.
- [24]. Artvin Province 2016 Yearly Environmental Status Report, Artvin Provincial Directorate of Environment and Urbanism EIA and Environment Services Directorate, 2017.
- [25]. Komilis DP. Issues on medical waste management research. *Waste Manag*. 2016; 48: 1-2 [26] Lee BK, Ellebecker MJ, Ersaso RM. Alternatives for treatment and disposal cost reduction of regulated medical wastes. *Waste Management*. 2004; 24(2):143-151
- [26]. Marinkovic N, Vitale K, Hoker NJ, Dzakula A, Pavic T. Management of hazardous medical waste in Croatia. *Waste Management*. 2008; 28(6):1049-1056. [27] Turkey Ministry of Environment and Urbanization. Turkish Medical Waste Control Regulation, Official Gazette No: 29959. 2017; Ankara, Turkey. [28] Debere MK, Gelaye KA, Alamdo AG, Trifa ZM. Assessment of the health care waste generation rates and its management system in hospitals of Addis Ababa, Ethiopia, 2011, *BMC Public Health*. 2013; 13:13-28.
- [28]. Patwary MA, O'Hare WT, Street G, Hossain SS. Quantitative assessment of medical waste generation in the capital city of Bangladesh. *Waste Management*. 2009; 29(8), 2392-2397.
- [29]. Gusca J, Kalnins SN, Blumberga D, Bozhko L, Khabdullina Z, Khabdullin A. Assessment method of health care waste generation in Latvia and Kazakhstan. *Energy Procedia* 2015; 72:175 - 179
- [30]. Sartaj M, Arabgol R. Quantitative Assessment and statistical analysis of medical waste generation in developing countries: a case study in Isfahan (Iran), *Transactions of Civil Engineering*. 2014; 38(2):409-420
- [31]. Kömbe A. Statistics, Analysis and Reporting Department, Report Bulletin, Analysis of Medical Waste Data. 2015. [internet]. Turkey, [cited 23 July 2017]. Available from www.tkhk.gov.tr.

Kazım onur Demirarslan. "The Medical waste Inventory Analysis of the Eastern Black Sea Region: The Case of Artvin Province." *IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)*, vol. 11, no. 9, 2017, pp. 17-25.