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Derleme / Review

How is Global Climate Change Affecting Global Surgery and Surgical Nursing?
Küresel İklim Değişikliği Küresel Cerrahi ve Cerrahi Hemşireliğini Nasıl Etkiliyor?

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ABSTRACT

Climate change, which has become one of the biggest threats to human health in our age, has been a subject of increasing concern from past to present. The nature, severity and frequency of diseases caused by climate change have the potential to negatively affect human health. There is an urgent need to improve perioperative care to address the unmet surgical disease burden, particularly in low- and middle-income countries. Today, as the necessity and prevalence of surgical interventions have increased, the prevention and treatment of complications arising from these procedures has become of paramount importance. Since climate change is a matter of social justice, nurses, who constitute the largest group among health care professionals, are obliged to encourage people and intervene in climate change in order to ensure social justice. This review aims to explain the effects of the climate crisis on the field of surgery, surgical care and surgical nursing.

Keywords: Climate change, General surgery, Operating room, Surgical nursing

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ÖZET

Çağımızda insan sağlığına yönelik en büyük tehditlerden biri haline gelen iklim değişikliği, geçmişten günümüze giderek artan bir endişe konusu olmuştur. İklim değişikliğinin neden olduğu hastalıkların doğası, şiddeti ve sıklığı insan sağlığını olumsuz etkileme potansiyeline sahiptir. Özellikle düşük ve orta gelirli ülkelerde karşılanmamış cerrahi hastalık yükünü ele almak için perioperatif bakımın iyileştirilmesine acil ihtiyaç vardır. Günümüzde cerrahi müdahalelerin gerekliliği ve yaygınlığı arttıkça, bu prosedürlerden kaynaklanan komplikasyonların önlenmesi ve tedavisi büyük önem kazanmıştır. İklim değişikliği bir sosyal adalet meselesi olduğundan, sağlık bakım profesyonelleri arasında en büyük grubu oluşturan hemşireler, sosyal adaleti sağlamak için insanları teşvik etmek ve iklim değişikliğine müdahale etmekle yükümlüdür. Bu derleme, iklim krizinin cerrahi, cerrahi bakım ve cerrahi hemşireliği alanına etkilerini açıklamayı amaçlamaktadır.

Anahtar Kelimeler: İklim değişikliği, Cerrahi hemşireliği, Genel cerrahi, Ameliyathane



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INTRODUCTION

Climate is defined as ‘the average of meteorological events called temperature, humidity, atmospheric pressure, wind, precipitation and other meteorological events on the earth's surface over a certain period of time’ (TRGM, 2021). Climate change is defined as the temperature increase on the earth's surface, which develops in addition to the natural climate change at certain comparable times, disrupts the composition of the atmosphere, and occurs as a result of direct and indirect human activities (Azizoglu, Sarioglu, Siyahli & Mehmetoglu; 2023; Davarcioglu, 2018; Demirbas & Aydin, 2020; ICN, 2018).

It is known that mankind has been continuously confronted with the ongoing effects of climate change since ancient times (Aras & Demirci, 2020). It is argued that humans have a great share in the continuous need for energy with the intensive and misuse of energy with the industrial revolution (Aras & Demirci, 2020; Balliel, Aydemir, Arik, Can, 2022). Continuous progress in technology, population growth and misuse of energy resources adversely affect nature and the environment, and as a result, it is stated that climate change is inevitable (Cecen & Guvenc, 2022). It is reported that the abnormal increase in the rate of greenhouse gas emissions such as carbon dioxide, methane, diazot monoxide, which are human-induced due to the decrease in fossil fuels, deforestation, agriculture and livestock activities, cement production and wastes, and the effects of industrialisation and continuous urbanization trigger global climate change (Davarcioglu, 2018; Demirbas & Aydin, 2020).

Today, the term ‘climate change’ has been replaced by the term ‘climate crisis’ (Muslu, 2021). It is stated that the climate crisis, the effects of which we are intensively exposed to, is one of the biggest threats to human health (Aras & Demirci, 2020; Roa et al., 2020). Considering that the climate crisis causes more devastating effects especially in poor and developing regions and countries, it is seen that it negatively affects health and life by increasing the burden of disease (Roa et al., 2020; Landrigan et al., 2018). In order to understand how the climate crisis affects global surgery and surgical nursing, it is important to first examine the effects of climate change on the field of surgery, to clarify what can be done in this regard and to explain the duties of nurses related

to the climate crisis. In the light of this information, this review aims to explain the effects of the climate crisis on surgical care and surgical nursing, and it is thought that this review will guide new studies to be carried out in the field of surgery.

How Can Climate Change Affect Global Surgery?

Carbon footprint measurements have become increasingly important as greenhouse gases and other contributing factors play a critical role in climate change (Senturk, Gok & Kocyigit, 2023). Surgical care is a health service that requires advanced surgical technologies, life support systems, expensive equipment and sterilization procedures. Surgical interventions require significant energy and material resources and generate substantial amounts of waste material (MacNeill, Lillywhite & Brown, 2017). Although surgeries greatly increase the quality of life and survival time, the carbon footprint of surgical care is quite large, accounting for almost 4.4%-4.6% of the total global carbon amount (Eckelman et al., 2020; Ewbank, Gianaris & Kushner, 2023). Therefore, the amount of carbon generated also contributes to climate change.

In this respect, if we evaluate the operating rooms and the hospitals in which they are located as a whole, we can say that the operating rooms are the units in hospitals that use resources most intensively and increase the carbon footprint the most (Inan & Satirlar, 2023). For this reason, it is reported that perioperative practices have significant effects on the environment (AORN, 2020), and studies have shown that operating rooms consume (three to six times) more energy compared to other units of hospitals (Davies, Ikin, Francis & McGain, 2023; Inan & Satirlar, 2023; MacNail et al., 2017; Perry et al., 2023). In addition to the waste production of plastic packaging and disposable materials used in operating rooms (Kyle, 2024; Perry et al., 2023), which produce more than 30% of all hospital waste, it is also mentioned that a large amount of energy is needed for heating and ventilation in these units (Perry et al., 2023). In addition to these studies, the factors that increase the carbon footprint in operating rooms are summarised in Table 1 (Gordon, 2020; Herr, Outtersen & Aggarwal, 2022; Inan & Satirlar, 2023; Sherman, 2019).

Table 1. Factors Increasing Carbon Footprint in Operating Rooms

Situations that Increase Carbon Footprint	Factors
High Energy Consumption	<ul style="list-style-type: none"> • Used devices, machines • Ventilation/oxygen/heating-cooling systems • Lighting systems
Consumables Used	<ul style="list-style-type: none"> • Materials and equipment to be used during the operation (injectors, sutures, sterile sets, etc.) • Drugs, wasted drugs used in anaesthesia (narcotics, benzodiazepines, barbiturates, ketamine, propofol, atropine, epinephrine, phenylephrine, succinylcholine, ephedrine etc.)
High Waste Generation	<ul style="list-style-type: none"> • Medicine boxes, glass vials, PVC serum bags, surgical gowns, blu wrap materials, oxygen masks, piercing-cutting tools • Disposable plastic products, disposable laryngoscopes and devices • Anaesthetic gases (isoflurane, desflurane, sevoflurane and diazot monoxide)

There are very few studies examining the effects of climate change on surgical care (Roa et al., 2020; MacNeill et al., 2017; Ewbank et al., 2023; Salam et al., 2023; Yates et al., 2023). It is mentioned that increasing temperature with climate change has some negative effects on perioperative care and increases the risk of surgical site infection (Roa et al., 2020; Aghdassi, Gastmeier, Hoffmann & Schwab, 2021). It is known that adequate and balanced nutrition helps to strengthen the body's immune system and also accelerates surgical wound healing. However, in cases where the necessary nutrients are deficient, these processes are disrupted and the healing process is prolonged. For this reason, it is seen that the negative effects of malnutrition on wound healing become more evident with the problem of food insecurity caused by climate change. The decline in local production leads to the weakening of the local agricultural sector, increasing external dependency and leading to imported food consumption. Therefore, this situation makes it difficult for the local population to have a healthy and balanced diet and increases the risk of the spread of chronic diseases such as obesity. And also, the decreasing availability of recreational areas also limits the physical activity opportunities of people and causes the spread of lifestyle-related diseases (Roa et al., 2020; Swerdal, Janevic, Cosgrove, Kostis & Myocardial Infarction Data Acquisition System (MIDAS 24), 2014).

Besides this, irritation of the respiratory tract may occur due to air pollution, while smoke and harmful gases from forest fires may impair respiratory function. Moreover, heat waves may cause an increase in body temperature and strain

the cardiovascular system. These respiratory and cardiovascular diseases may also adversely affect perioperative care (Swerdal et al., 2014). Furthermore, even though long-term care for non-communicable diseases is frequently non-surgical, ischemic heart disease necessitates surgical procedures like coronary artery bypass surgery (Roa et al., 2020).

Moreover, natural disasters and rising sea levels can have serious consequences, placing increased pressure on health systems and leading to geopolitical impacts (Dimanchev et al., 2019). At the same time, storms and floods increase the burden of traumatic injuries and surgical disease (Yates et al., 2023; Alkire et al., 2015). Therefore, this situation requires health systems to be prepared for a good disaster plan and to provide trauma care (Pyda et al., 2019). Also, in case of any natural disaster, there may be difficulties in producing and supplying drugs, surgical materials and equipment. Therefore, creating disaster-resistant surgical health systems becomes very important in terms of providing adequate intervention in natural disasters (Roa et al., 2020; Salam et al., 2023). Providing low-cost and sustainable energy infrastructure is also a very important issue in terms of ensuring safe surgery today, especially given that approximately five billion people lack access to safe surgical service (Roa et al., 2020). Although climate change affects all humanity, it exacerbates existing inequalities, leading to increased expenditures and disability and harmful health effects on poor people. This further limits their access to care (Temple, 2019). It is stated that the groups in the

world who have difficulty in accessing health services economically are generally the poor, homeless, prisoners, migrants and other vulnerable groups (Suhreke et al., 2011). It is known that these groups, who have problems in accessing prevention and treatment due to lack of financial means, are excluded from the health system when language and cultural differences come into play (Parekh & Rose, 2011).

What can be done?

- It is stated that climate change will result in an increased prevalence of surgical diseases as a consequence of the rise in trauma, injury and non-communicable diseases (Roa et al., 2020). In the provision of services to reach vulnerable groups in this direction, the use of telemedicine applications in preoperative and postoperative consultations or the use of drones in the distribution of blood products to minimise the impact of transportation can be considered as an effort to increase the surgical, obstetric and anaesthesia care of countries (Citron, Sonderman, Subi & Meara, 2019).
- At the same time, it is stated that the selection of electric or hybrid electric vehicles for the transfer of patients, materials and even the organ required for organ transplantation in surgical care, and the preference of drones in the transport of materials required for surgery such as equipment and organs will contribute to the prevention of climate change by reducing the carbon footprint (Scalea et al., 2021).
- In addition, operating rooms are special environments requiring a safe environment, sensitive controls and sterility. In operating rooms, which in itself increases the carbon footprint, large energies are needed to provide optimum conditions. For this reason, the presence of motion-activated sensors in operating rooms and the ability of special systems to switch to standby mode when the rooms are not in use will help reduce carbon emissions in efforts to prevent the climate crisis (Ewbank et al., 2023).
- Also, it has been reported that 93-118 kg/person carbon emissions per operation can be reduced by reducing the use of inhaled anaesthetic desflurane used in general anaesthesia induction in operating rooms (Charlesworth & Swinton, 2017; Ewbank et al., 2021).
- In addition, practices that can reduce the carbon footprint in operating theatres include

those that can reduce water use, especially in the preoperative period. A moisturising, waterless, brushless hand antiseptic called 'Avagard', approved by the Food and Drug Administration (FDA), has been produced instead of hand brushing in traditional surgical applications (Gul & Aygin, 2020). It has been reported that these antiseptics facilitate pre-surgical hand preparation without compromising patient safety, with hand preparation being completed by rubbing each hand with only five millilitres of solution for three minutes (Chen, Han, Kan, Chen & Hung, 2012). It is asserted that these alcohol-based hand antiseptics may be a suitable option, particularly in circumstances where access to water sources is limited (Abaza, Amine & Hazzah, 2010).

- Another application in climate change prevention initiatives is the reusability of equipment used in operating rooms. Although minimally invasive surgical interventions provide advantages for patients in many ways, the fact that the materials used during the intervention are generally disposable leads to an increase in the carbon footprint, thus increasing the climate crisis. With the transition to robotic surgery, an advantage has been provided by sterilising the materials due to their robustness and enabling them to be used more than once. Still, it has been reported that carbon emissions have increased due to the single use of drapes, wires and other accessories during the intervention. Therefore, although the technologies used in minimally invasive and robotic surgical interventions have advantages, it is recommended to consider these risks (Ewbank et al., 2023).

The Relationship of Climate Change With Nursing and the Duties of Nurses in Climate Crisis

The International Council of Nurses (ICN) states that climate change is a social justice issue (ICN, 2018). Nurses, who constitute the largest group among health professionals, are obliged to encourage people to ensure social justice through the work they fulfill, and they are also obliged to intervene in climate change (Adrian, 2020; Cook, Demorest & 2020; Kurt, 2017; Law, Kalogirou & Dahlke 2021). It is stated that nurses can achieve success in creating mass change by ensuring social justice, improving health, and addressing any health problem due to their large number (Law et al., 2021).

Canadian Nurses Association (CNA) states that nurses are ideally positioned to help mitigate the effects of climate change in health services due to their scientific knowledge, communication skills, expertise in health promotion and behaviour change (CNA, 2017). In addition, the advocacy roles of nurses and their ability to address and evaluate health effects and inequalities through policy studies enable nurses to be at the forefront of efforts to mitigate climate change (Divakaran, Lembeck, Kerr, Calmus & Potter, 2016; Nicholas, Breakey, Tagliareni, Simmonds & Sabo, 2021). In the literature, it is stated that action has been taken to provide more clarity and understanding about why and how nurses should be involved in the fight against climate change. The social duties of nurses to promote health, including reducing the negative effects of climate change on health, are shown as an important reason for nurses to be involved in climate change (CNA, 2009; Leffers, Levy, Nicholas & Sweeney, 2017; Nicholas, 2019; Saber, 2020).

When the literature on climate change is examined, it is mentioned that the majority of nurses are aware that human-induced climate change has become a critical issue (Anåker, Nilsson, Holmner & Elf, 2015; Kalogirou, Dahlke, Davidson & Yamamoto, 2020). In a study, it was found that 90% of the nurses believed that some or all of the climate change was caused by humans and 66% of them believed that climate change was worrying and they doubted the ability of nurses to affect the problem of climate change (Polivka, Chaudry & Mac Crawford, 2012). In another study, it was concluded that most of the nurses still lacked the understanding that there is a relationship between nursing roles and climate change, were not sure whether nursing has a role in mitigating climate change, and considered this issue as a higher level issue that exists outside of nursing (Kalogirou et al., 2020). In the study of Anåker et al. (2015), it is stated that nurses think they cannot transform the knowledge they have acquired about climate change into action. The Nurses Climate Challenge aims to educate 50,000 healthcare professionals about climate change and healthcare services by 2022 and focuses on this problem by providing comprehensive resources for nurses to start educating their colleagues (Cook et al., 2020).

Therefore, the roles of nurses in this issue have been stated by considering the leadership and guiding characteristics of nurses in climate change (Tekin & Korkmaz, 2022). Nurses;

- They should evaluate the effects of changes occurring in the ecosystem on human health and take the lead in health planning (Rosa & Upvall, 2019).
- They should create conceptual models about the biological effects of climate change on human health (Peregrin, 2015), make preparation and action plans against disasters and natural events, and include the concepts of population mobility, migration and conflict in disaster planning (Tekin & Korkmaz, 2022).
- They should advocate social justice by addressing the impacts of climate change in terms of socioeconomic inequalities (Rosa & Upvall, 2019).
- In their efforts to reduce their carbon footprint, they should individually contribute to the prevention of climate change and the health of the planet by exhibiting green actions (using public transport, bicycles or electric transport vehicles, saving water and energy, sorting and recycling garbage, reducing the use of plastic, developing education and awareness on this issue) (Law et al., 2021; Tekin & Korkmaz, 2022). In addition, since carbon footprint is a factor to be considered when choosing a surgical technique, it should be taken into consideration that operating theatres consume three to six times more energy than the entire hospitals. Operating theatres should be ventilated to maximise the efficient use of operating theatres and minimise unnecessary energy consumption and carbon footprint (Roa et al., 2020; MacNeill et al., 2017).
- It is important to inspect and regulate the existing energy sources in the operating theatres, to ensure the transition to renewable power sources and to prevent the evaluation of non-biohazardous wastes as hazardous because they produce more carbon dioxide (Peregrin, 2015). It is stated that nurses have an important role in knowledge, attitudes and practices related to waste management in preventing hazards arising from waste (Mat & Baykal, 2020).
- Nurses should work with unions, associations and decision-makers with a multidisciplinary approach in order to reduce and adapt the negative effects of climate change and contribute to the establishment of effective policies. In addition, nurses should have duties and responsibilities to create policies

on this issue and to support the policies created. They should be able to use their advocacy roles at local, national and even global levels (Tekin & Korkmaz, 2022).

- Patients/caregivers should be educated in order to improve their own health and to protect natural resources for the health of the world (İlaslan & Cakar, 2021)
- They should conduct research on climate change and climate crisis by fulfilling their research and practice roles (Tekin & Korkmaz, 2022).
- In addition, since it is important to educate nurses and nursing students about climate change, courses should be added to the undergraduate curriculum, nurses working with in-service training should be informed about these issues and certificate programmes should be established (Tekin & Korkmaz, 2022).

CONCLUSION

Climate change, one of the biggest problems of our age, negatively affects human health by changing the emergence, nature, severity and frequency of diseases affecting human health. Especially in low-income countries, the quality of perioperative care decreases due to the inadequacy of qualified health personnel and health infrastructure, thus affecting the rapid recovery processes of patients and negatively affecting their quality of life. In this direction, it has become one of the important issues of today that health systems in the climate crisis are resistant to the rapidly changing environment, capable of meeting the need for surgical care and strengthening the care process in a way that does not cause the climate crisis.

In addition, in the management of the surgical process in the climate crisis, it is extremely important to implement innovative and disciplined systems that reduce greenhouse gas emissions, and for surgical nurses to maintain the surgical care process in a way that includes health equality and social justice. It is predicted that nurses, who constantly follow current global events, and innovations and take part in important tasks in efforts to improve global health, will make great contributions to the prevention of the climate crisis.

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Conflict of Interest

The authors have no conflict of interest to declare.

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KAYNAKLAR

- Abaza, A. F., Amine, A. E., Hazzah, W. A. (2010). Comparative study on efficacy of different alcohol hand rubs and routine hand wash in a health-care setting, Alexandria, Egypt. *The Journal of the Egyptian Public Health Association*, 85(5-6), 273-283.
- Adrian, A. (2020). Climate and health. *Journal of Perioperative Nursing*, 33(1), 9–11. doi: 10.26550/2209-1092.1077
- Aghdassi, S. J., Gastmeier, P., Hoffmann, P., Schwab, F. (2021). Increase in surgical site infections caused by gram-negative bacteria in warmer temperatures: results from a retrospective observational study. *Infection Control & Hospital Epidemiology*, 42(4), 417-424.
- Alkire, B. C., Raykar, N. P., Shrimel, M. G., Weiser, T. G., Bickler, S. W., Rose, J. A., ..., Farmer, P. E. (2015). Global access to surgical care: a modelling study. *Lancet Global Health*, 3(6), e316-e323. doi: 10.1016/S2214-109X(15)70115-4
- Anåker, A., Nilsson, M., Holmner, Å., Elf, M. (2015). Nurses' perceptions of climate and environmental issues: a qualitative study. *Journal of Advanced Nursing*, 71(8), 1883–1891. doi: 10.1111/jan.12655
- Association of periOperative Registered Nurses (AORN) (2020). *AORN position statement on environmental responsibility*. Denver, CO: AORN, Inc; 2020. Accessed: 14.11.2024. <https://www.aorn.org/docs/default-source/guidelines-resources/position-statements/patient-workplace-safety/posstat-safety-environmental-responsibility.pdf>
- Aras, B. B., Demirci, K. (2020). Psychological effects of climate change on human health. *Nazilli İktisadi ve İdari Bilimler Fakültesi Dergisi*, 1(2), 77-94.
- Azizoglu, N., Sarioglu, Y. H., Siyahli, N., Mehmetoglu, E. (2023). A brief overview of the climate crisis from Turkey with descriptive methods. *Ankara University Journal of Social Sciences*, 14(2), 108-

- 136.
- Balliel, N., Aydemir, E., Arik, B., Can, B. (2022). Human and child health in terms of the effects of climate change. *II. International Health and Climate Congress (IHCC)*, pp, 113-118
- Canadian Nurses Association (CNA) (2009). Environmentally responsible activity in the health care sector. *Joint Position Statement*, pp:2-5. https://hl-prod-ca-oc-download.s3-ca-central-1.amazonaws.com/CNA/2f975e7e-4a40-45ca-863c-5ebf0a138d5e/UploadedImages/documents/JPS9_9_Environmental_e.pdf. Accessed 1 April 2024.
- Canadian Nurses Association (CNA) (2017). Climate change and health position statement. https://hl-prod-ca-oc-download.s3-ca-central-1.amazonaws.com/CNA/2f975e7e-4a40-45ca-863c5ebf0a138d5e/UploadedImages/documents/Climate_change_and_health_position_statement.pdf. Accessed 10 April 2024.
- Cecen, Z., Guvenc, F. (2022). The Effects of climate change and global warming on warming on public health. *SDU Healthcare Management Journal*, 4(1), 14-25.
- Charlesworth, M., Swinton, F. (2017). Anaesthetic gases, climate change, and sustainable practice. *Lancet Planet Health*, 1(6), e216–e217. doi: 10.1016/S2542-5196(17)30040-2
- Chen, C. F., Han, C. L., Kan, C. P., Chen, S. G., Hung, P. W. (2012). Effect of surgical site infections with waterless and traditional hand scrubbing protocols on bacterial growth. *American Journal of Infection Control*, 40(4), 15-17.
- Citron, I., Sonderman, K., Subi, L., Meara, J. G. (2019). Making a case for national surgery, obstetric, and anesthesia plans. *Canadian Journal of Anaesthesia*, 66, 263–71.
- Cook, C., Demorest, S. L., Schenk, B. (2020). Nurses climate challenge: educating 50,000 health professionals by 2022. *Alaska Nurse*, 71(1), 8–9.
- Davarcioglu, B. (2018). Kuresel iklim degisikligi ve uyum calismalari: Turkiye acisindan degerlendirilmesi. *Mesleki Bilimler Dergisi*, pp, 376-392.
- Davies, J. F., Ikin, B., Francis, J. J., McGain, F. (2023). Implementation approaches to improve environmental sustainability in operating theatres: a systematic review. *British Journal of Anaesthesia*, 133(6), 1383-1396. doi: 10.1016/j.bja.2023.05.017
- Demirbas, M., Aydin, R. (2020). The Biggest threat of the 21st century: global climate change. *Ecological Life Sciences*, 15(4), 163-179.
- Dimanchev, E. G., Paltsev, S., Yuan, M., Rothenberg, D., Tessum, C. W., Marshall, J. D., Selin, N. E. (2019). Health co-benefits of sub-national renewable energy policy in the US. *Environmental Research Letters*, 14(8), 085012. doi: 10.1088/1748-9326/ab31d9
- Divakaran, B., Lembeck, S., Kerr, R., Calmus, H., Potter, T. (2016). Nurses see “the big picture”: Addressing climate change as a social determinant of global health. *Creative Nursing*, 22(4), 243–248. doi: 10.1891/1078-4535.22.4.243
- Eckelman, M. J., Huang, K., Lagasse, R., Senay, E., Dubrow, R., Sherman, J. D. (2020). Health care pollution and public health damage in the United States: an update. *Health Aff (Millwood)*, 39(12), 2071–2079.
- Ewbank, C., Stewart, B., Bruns, B., Deckelbaum, D., Gologorsky, R., Groen, R., ..., Kushner, A. (2021). The development of a surgical care and climate change matrix: a tool to assist with prioritization and implementation strategies. *Annals of Surgery*, 273(2), e50–e51. doi: 10.1097/SLA.0000000000003980
- Ewbank, C., Gianaris, K., Kushner, A. L. (2023). Climate change and surgical implications. *Emergency and Critical Care Medicine*, 3(1), 4–5. doi: 10.1097/EC9.0000000000000052
- Gordon, D. (2020). Sustainability in the operating room reducing our impact on the planet. *Anesthesiology Clinics*, 38, 679–692. doi: 10.1016/j.anclin.2020.06.006
- Gul, A., Aygin, D. (2020). Temiz su kaynaklari azalirken cerrahi el hazirliginda geleneksel yontem mi susuz el antisepsisi mi? *Sakarya Üniversitesi Holistik Sağlık Dergisi*, 3(2), 112-129.
- Herr, M. M., Outterson, R. E., Aggarwal, S. (2022). Lost in the ether: the environmental impact of anesthesia. *Operative Techniques in Orthopaedics*, 32(4), 100997. doi: 10.1016/j.oto.2022.100997
- Ilaslan, N., Cakar, M. (2021). 2030 surdurulebilir kalkinma hedefleri kapsaminda gezegen sagligi ve gezegen hemsireliginin onemi. *Türkiye Klinikleri Journal of Nursing Sciences*, 13(3), 717-724. doi: 10.5336/nurses.2020-79658
- Inan, G., Satirlar, Z. O. (2023). Anestezinin kuresel isinmaya etkisi ve surdurulebilir anestezi gercegi. *JARSS*, 31(4), 253-266. doi: 10.54875/jarss.2023.57804
- International Council of Nurses (ICN) (2018). Nurses, climate change, and health. https://www.icn.ch/sites/default/files/inline-files/ICN_PS_Nurses%252c_climate_change_and_health_FINAL.pdf. Accessed 2 April 2024.
- Kalogirou, M. R., Dahlke, S., Davidson, S., Yamamoto, S. (2020). Nurses’ perspectives on climate change, health and nursing practice. *Journal of Clinical Nursing*, 29(23/24), 4759–4768. doi: 10.1111/jocn.15519
- Kurth, A. E. (2017). Planetary health and the role of

- nursing: A call to action. *Journal of Nursing Scholarship*, 49(6), 598–605. doi: 10.1111/jnu.12343
- Kyle, E. (2024). Sustainability in the perioperative practice setting. *AORN journal*, 119(3), 226-232. doi: 10.1002/aorn.14101
- Landrigan, P. J., Fuller, R., Acosta, N. J. R., Adeyi, O., Arnold, R., Basu, N., ..., Zong, M. (2018). The Lancet Commission on pollution and health. *Lancet*, 391, 462–512.
- Law, J., Kalogirou, M. R., Dahlke, S. (2021). Nurses as boundary actors in sustainable health care: a discussion paper. *Witness: The Canadian Journal of Critical Nursing Discourse*, 3(2), 36-46. doi: 10.25071/2291-5796.105
- Leffers, J., Levy, R. M., Nicholas, P. K., Sweeney, C. F. (2017). Mandate for the nursing profession to address climate change through nursing education. *Journal of Nursing Scholarship*, 49(6), 679–687. doi: 10.1111/jnu.12331
- MacNeill, A. J., Lillywhite, R., Brown, C. J. (2017). The impact of surgery on global climate: a carbon footprinting study of operating theatres in three health systems. *Lancet Planet Health*, 1:e381–88.
- Mat, S. T. B., Baykal, U. (2020). Medical waste management and zero waste approach in healthcare organizations. *Journal of Health and Nursing Management*, 7(3), 441-449.
- Muslu, M. (2021). Alternative foods of the future in the face of global climate crisis and nutrition problems. *Climate and Health Journal*, 1(2), 74-81.
- Nicholas, P. K. (2019). The economics of climate change and the intersection with conflict, violence, and migration: implications for the nursing profession. *Nursing Economics*, 37(1), 23–34.
- Nicholas, P. K., Breakey, S., Tagliareni, M. E., Simmonds, K., Sabo, K. K. (2021). Climate change and population health: incorporating stages of nursing's political development. *Nursing Outlook*, 69(1), 65–73. doi: 10.1016/j.outlook.2020.08.001
- Parekh, N., Rose, T. (2011). Health inequalities of the Roma in Europe: a literature review. *Central European Journal of Public Health*, 19, 139-142.
- Peregrin, T. (2015). Strategies for sustainability: going green in the OR. Chicago, IL: Bulletin of the American College of Surgeons. <https://bulletin.facs.org/2015/05/strategies-for-sustainability-goinggreen-in-the-or>. Accessed 6 May 2024.
- Perry, H., Reeves, N., Ansell, J., Cornish, J., Torkington, J., Morris, D. S., ..., Horwood, J. (2023). Innovations towards achieving environmentally sustainable operating theatres: a systematic review. *The Surgeon*, 21(3), 141-151.
- Polivka, B. J., Chaudry, R. V., Mac Crawford, J. (2012). Public health nurses' knowledge and attitudes regarding climate change. *Environmental Health Perspectives*, 120(3), 321–325. doi: 10.1289/ehp.1104025
- Pyda, J., Patterson, R. H., Caddell, L., Wurdeman, T., Koch, R., Polatty, D., Corlew, D. S. (2019). Towards resilient health systems: opportunities to align surgical and disaster planning. *BMJ Global Health*, 4(3), e001493. doi: 10.1136/bmjgh-2019-001493
- Roa, L., Velin, L., Tudravu, J., McClain, C. D., Bernstein, A., Meara, J. G. (2020). Climate change: challenges and opportunities to scale up surgical, obstetric, and anaesthesia care globally. *Lancet Planet Health*, 4(11):e538-e543. doi: 10.1016/S2542-5196(20)30247-3
- Rosa, W. E., Upvall, M. J. (2019). The case for a paradigm shift: from global to planetary nursing. *Nursing Forum*, 54(2), 165-170.
- Saber, D. A. (2020). Healthcare's role in environmental sustainability: RNs are needed to guide efforts. *American Nurse Today*, 15(10), 50–53.
- Salam, A., Wireko, A. A., Jiffry, R., Ng, J. C., Patel, H., Zahid, M. J., ..., Isik, A. (2023). The impact of natural disasters on healthcare and surgical services in low-and middle-income countries. *Annals of Medicine and Surgery*, 85(8), 3774-3777.
- Scalea, J. R., Pucciarella, T., Talaie, T., Restaino, S., Drachenberg, C. M., Alexander, C., ..., Scassero, M. B. S. (2021). Successful implementation of unmanned aircraft use for delivery of a human organ for transplantation. *Annals of Surgery*, 274(3), e282–e288. doi: 10.1097/SLA.0000000000003630
- Senturk, G. O., Gok, G., Kocyigit, H. (2023). Carbon footprint in soil and its impact on climate change. *Artvin Coruh University Journal of Engineering and Sciences*, 1(1), 12-24.
- Sherman, J. (2019). Reusable vs. disposable laryngoscopes. *APSF Newsletter*, 33, 91. Available at: <https://www.apsf.org/article/reusable-vs-disposable-laryngo-scopes/>.
- Suhrcke, M., Stuckler, D., Suk, J.E., Desai, M., Senek, M., McKee, M., ..., Semenza, J. C. (2011). The impact of economic crises on communicable disease transmission and control: a systematic review of the evidence. *PLOS One*, 6, e20724. doi: 10.1371/journal.pone.0020724
- Swerdel, J. N., Janevic, T. M., Cosgrove, N. M., Kostis, J. B., and Myocardial Infarction Data Acquisition System (MIDAS 24) Study Group (2014). The effect of Hurricane Sandy on cardiovascular events in New Jersey. *Journal of the American Heart Association*, 3, e001354.
- T.C. Tarım ve Orman Bakanlığı, Tarım Reformu Genel

- Mudurlugu (TRGM) (2021). İklim deęisikligi ve tarım deęerlendirme raporu. <https://www.tarimorman.gov.tr/TRGM/Belgeler/IKLIM%20DEGISIKLIGI%20VE%20TARIM%20DEGERLENDIRME%20RAPORU.pdf>. Accessed 1 May 2024.
- Tekin, S., Korkmaz, A. C. (2022). Nurses' stance against climate crisis: Planetary health nursing. *II. International Health and Climate Change Congrees (IHCC)*, pp:100-105.
- Temple, J. (2019). Climate change has already made poor countries poorer and rich countries richer. <https://www.technologyreview.com/s/613386/climate-change-has-already-made-poor-countries-poorer-and-rich-countries-richer>. Accessed 10 April 2024.
- Yates, E. F., Velin, L., Cronin, A., Naus, A., Forbes, C., Bowder, A. N., ..., McClain, C. D. (2023). The Impact of climate change on surgical care: a systematic review of the bellwether procedures. *The Journal of Climate Change and Health*, 100274, 1-9. doi: 1016/j.joclim.2023.100274