GREEN HOSPITALS

Global Compact Network Poland

Know-How Hub
Centrum Transferu Wiedzy

PARTNER: PHILIPS

Network Poland

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OUR MISSION:
MOBILIZE A GLOBAL MOVEMENT OF SUSTAINABLE COMPANIES AND STAKEHOLDERS TO CREATE THE WORLD WE WANT

THE TEN PRINCIPLES OF THE UNITED NATIONS GLOBAL COMPACT

HUMAN RIGHTS

1 Businesses should support and respect the protection of internationally proclaimed human rights; and

2 make sure that they are not complicit in human rights abuses.

LABOUR

3 Businesses should uphold the freedom of association and the effective recognition of the right to collective bargaining;

4 the elimination of all forms of forced and compulsory labour;

5 the effective abolition of child labour; and

6 the elimination of discrimination in respect of employment and occupation.

ENVIRONMENT

7 Businesses should support a precautionary approach to environmental challenges;

8 undertake initiatives to promote greater environmental responsibility; and

9 encourage the development and diffusion of environmentally friendly technologies.

ANTI-CORRUPTION

10 Businesses should work against corruption in all its forms, including extortion and bribery.

Our world is challenged like never before. From climate change, to conflicts, to COVID-19, which is putting the Sustainable Development Goals further out of reach. It would be easy to lose hope, but we are not hopeless or helpless. We have a path to recovery If we choose to take it. That's what this SDG Moment is all about.

António Guterres
Secretary-General of the United Nations
Chair of the UN Global Compact Board

Source:
Speech at SDG Moment – a major event marking the start of the General Assembly High Level Week, 20th September 2021.


WOR
ECON
FOR

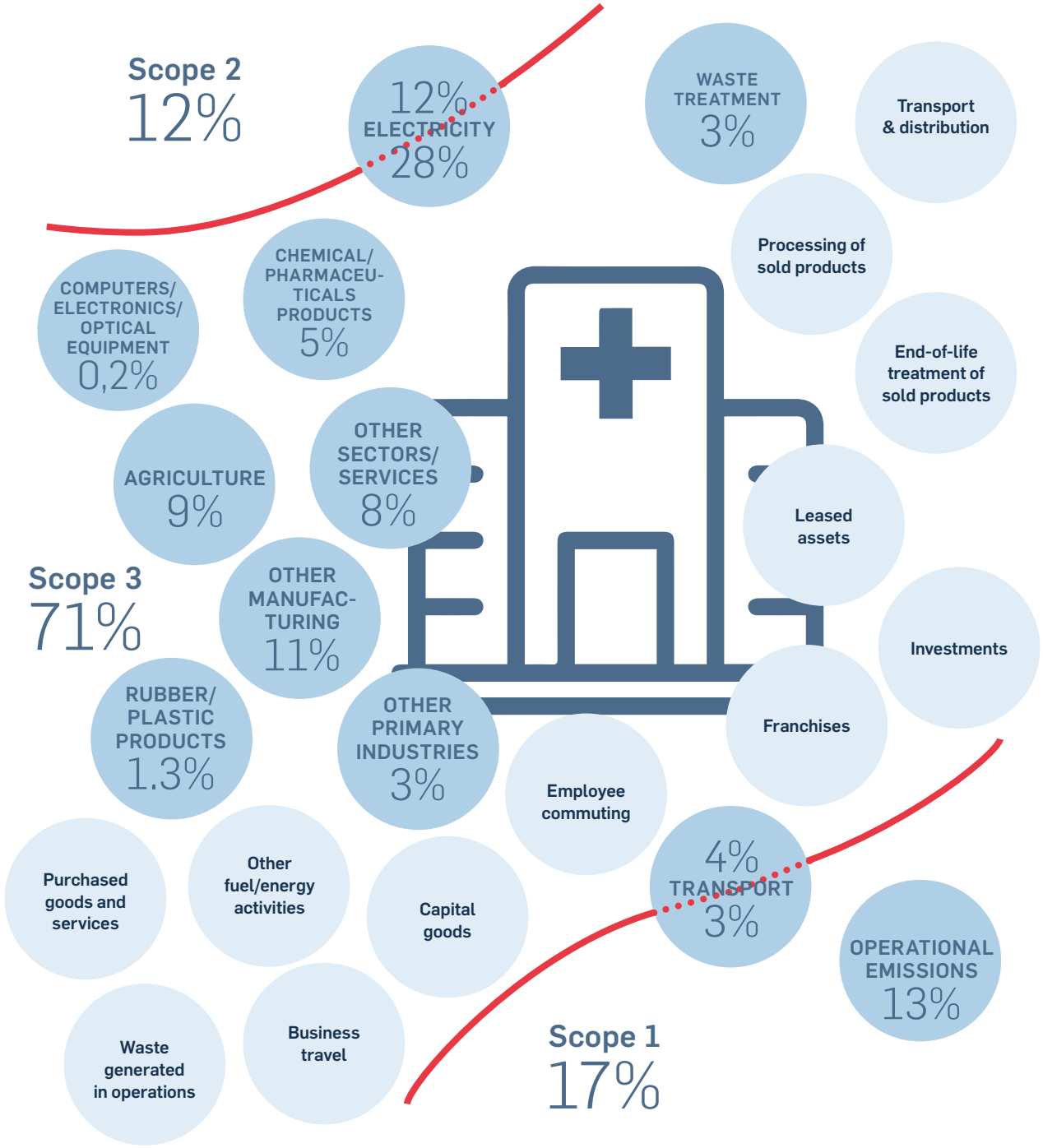
We have less than 10 years left to shift the world onto a 1.5°C trajectory, reduce global inequalities and achieve the substance of the SDG Agenda. Our changing climate means, more than ever, that we are running out of time.

Sanda Ojiambo
Assistant Secretary-General of the United Nations Global Compact, CEO & Executive Director UN Global Compact

Source:
Statement at COP27 in Sharm El Sheikh

INTRODUCTORY DATA

MEASURED AND UNMEASURED HEALTHCARE SECTOR ACTIVITIES THAT CONTRIBUTE TO GREENHOUSE GAS EMISSIONS BY SCOPE[3]



Source: A pathway to net zero emissions for healthcare https://doi.org/10.1136/bmj.m3785

More than

70%

of a health system's greenhouse gas emissions are embedded in products and services they buy. Hospitals can serve as responsible stewards by considering the total cost of ownership of products and cutting down on their own impacts and encouraging suppliers to do the same through sustainable procurement.

Source: Practice Greenhealth, https://practicegreenhealth.org/sustainableprocurementguide

There is a danger that environmental degradation and other pressures – such as increased human population densities, global trade and international mass transportation – will exacerbate the emergence of new zoonotic diseases. It is estimated that **1.7 million** currently undiscovered viruses exist in mammal and avian hosts, almost half of which may have the ability to infect humans (IPBES, 2020).

Source: A health perspective on the role of the environment in One Health, https://www.who.int/europe/publications/i/item/WHO-EURO-2022-5290-45054-64214

WHO estimates that **4.2 million** premature deaths globally in 2019 were due to ambient air pollution (WHO, 2022), with most attributable premature deaths seen in low and middle-income countries.

Source: Protecting health through ambient air quality management: a resource package for the WHO European Region, https://www.who.int/europe/publications/i/item/WHO-EURO-2023-6898-46664-67857

Because of the rapidly increasing temperatures, vulnerable populations (adults older than 65 years, and children younger than one year of age) were exposed to 3·7 billion more heatwave person-days in 2021 than annually in 1986–2005 (indicator 1.1.2), and heat-related deaths increased by 68% between 2000–04 and 2017–21 (indicator 1.1.5), a death toll that was significantly exacerbated by the confluence of the COVID-19 pandemic.

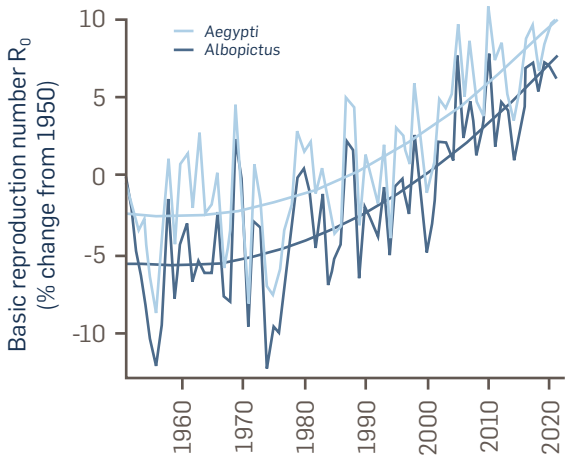
Source: The 2022 report of the Lancet Countdown on health and climate change: health at the mercy of fossil fuels, https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(22)01540-9/fulltext

INTRODUCTORY DATA

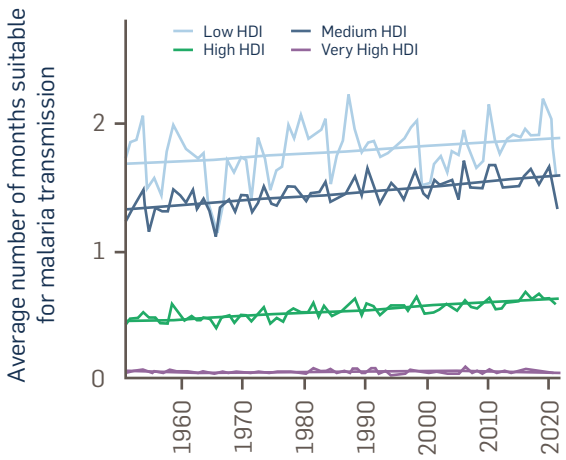
Change in climate suitability for infections diseases

The lines show the annual change. Thick lines show the trend since 1951 (for malaria), 1951 (for dengue), 1982 (for Vibro bacteria) and 2003 (for Vibrio cholerae). HDI– Human Development Index

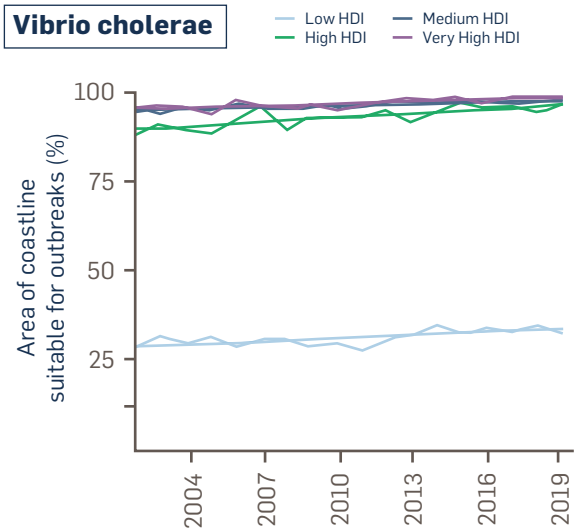
Dengue (global)



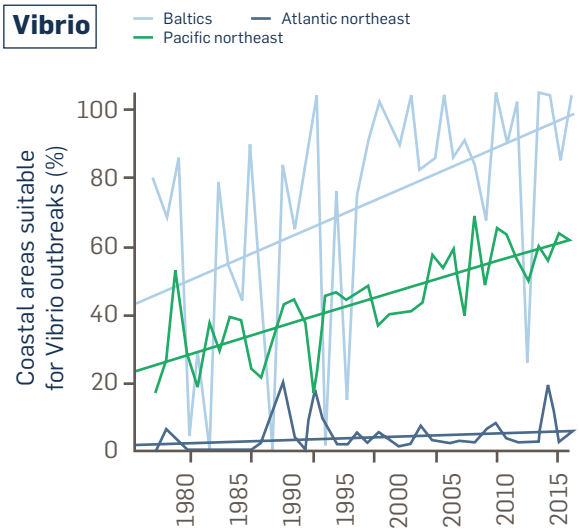
Malaria (highland)



Vibrio cholerae



Vibrio



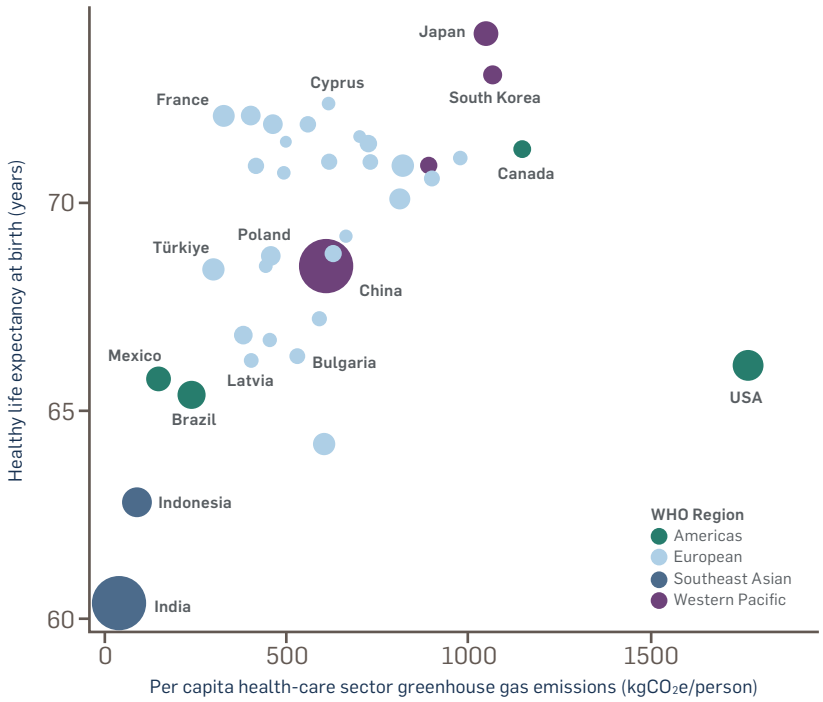
The climatic suitability for the transmission of dengue increased by 11,5% for Aedes aegypti and 12,0% for Aedes albopictus (which are mosquito species) from 1951–60 to 2012–21; the length of the transmission season for malaria increased by 31,3% in the highlands of the Americas and 13,8% in the highlands of Africa from 1951–60 to 2012–21.

Vibrio pathogens increased from 47,5% to 86,3% in the Baltic; from 30,0% to 57,1% in the US northeast; and from 1,2% to 5,7% in the Pacific Northwest; three regions where Vibriosis is regularly reported. An extra 4,3% of the coastal waters in northern latitudes (40–70°N) had temperatures suitable for Vibrio during 2014–21 compared with 1982–89, with 2021 being the second most suitable year on record (11,3% of the coastal area suitable), making brackish waters in these latitudes increasingly suitable for Vibrio transmission.

Source: The 2022 report of the Lancet Countdown on health and climate change: health at the mercy of fossil fuels, https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(22)01540-9/fulltext

National greenhouse gas emissions per person from the health-care sector against the healthy life expectancy at birth in 2019, by WHO region

The point circle size is proportional to country population $kgCO_2e$=kilograms of carbon dioxide equivalent.

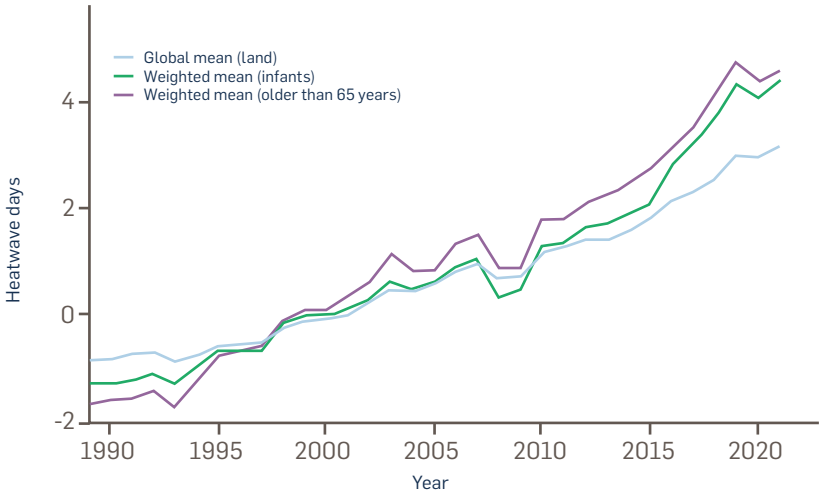


From 2018 to 2019, emissions from the health-care sector increased by more than 5%, reaching 5,2% of global greenhouse gas emissions

Source: The 2022 report of the Lancet Countdown on health and climate change: health at the mercy of fossil fuels, https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(22)01540-9/fulltext

Change in heatwave days compared with the 1986-2005 baseline (10-year rolling mean)

Heatwave days ere presented as mean-weighted by land surface area, mean-weighted by infant population, and mean-weighted by the popular older than 65 years.



Heat-related mortality of people older than 65 years increased by an estimated 68% between 2000–04 and 2017–21.

Source: The 2022 report of the Lancet Countdown on health and climate change: health at the mercy of fossil fuels, https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(22)01540-9/fulltext

SUMMARY

Climate change is already contributing to increased health problems across the world. Health care is uniquely positioned to play a leading role in combating climate change, which the scientific journal *The Lancet* has called the greatest health threat of the 21st century.

To meet this challenge, a relatively new idea of Green Hospitals – still underrated in Poland – has been put forward. Implementation of the idea of sustainable hospitals boils down to meeting the requirements of the Paris Agreement and the European Green Deal, which represent a commitment to, inter alia, reduce the effects of global warming, thus keeping the temperature rise below 1.5°C, cut emissions by at least 55% by 2030 (compared to 1990 levels) and make Europe a net zero continent in terms of carbon emissions by 2050.

How to do it?

The purpose of the report was to analyze the trends and measures taken to implement the idea of Green Hospitals. The authors of the document undertook an analysis of the key elements for the transformation of hospitals and their environment. Some of the biggest challenges in implementing the contemplated idea include:

- reduction of emissions in the health care sector,
- improvement of energy efficiency and energy storage in hospitals,
- digitization of hospitals,
- changing the approach to the construction and development of medical facilities, which should take into account the hospital's green surroundings,
- sustainable supply chain for the hospital food service,
- recycling of generated waste.

The authors of the report, which include government bodies, medical facilities, non-governmental organizations, as well as representatives of business and science, shared their experiences, thoughts and recommendations for the future regarding the development and implementation of viable solutions that would serve not only hospitals themselves, but also public buildings in general.

The broader scope results not only from widespread implementation of solutions used in hospital buildings, but also the impact of non-medical factors on the quality of the health sector's performance both at the national and global level. Energy transition, reorganization of transport and replacement of fossil fuel-based engines with units that have a lower environmental impact to reduce the impact of the supply chain, are key elements whose change is still beyond the direct interest of hospitals, where the supply chain accounts for 71% of all carbon emissions from the sector.

Improving such interdisciplinary knowledge of elements contributing to a sustainable hospital environment is also a challenge research-wise. There are no research methodologies and indicators that would define emission reductions for such facilities. Establishing such indicators should be the next step after studies of the sector's carbon performance.

An analysis of the operation of hospital facilities reveals that sanitary systems are in poor condition. Heat sources are worn out, inefficient and prone to frequent failures. Comfort heat and hot water

distribution systems lack insulation, tend to be corroded and leaking. In addition, hospital rooms are not ventilated and equipped with proper infrastructure for heat recovery. In the winter season, they are cooled by opening windows, while in the summer they heat up to high temperatures, posing a real danger to patients. The lack of systemic solutions is a disaster, and it will take years to implement any, which is why it is so important to make decisions on the necessary changes now.

The authors of the articles, drawing on their experiences from their own practice, also pointed to solutions that can help improve hospital infrastructure, efficiency, and thus contribute to positive climate action. These measures are diverse and multifaceted, but their complementary nature makes it reasonable to implement them as part of a consistent reform of the health sector. The most important ones include:

1.

A change in the approach to energy efficiency of hospitals, i.e. the use of renewable energy sources to power medical facilities. This practice has been increasingly used in Polish hospitals. One of the largest such installations has been set up on the building of the Independent Public Clinical Hospital No. 1 in Szczecin. The total installed capacity of PV panels is 740.60 kWp, making the installation one of the largest rooftop systems in the country. In just four months after installing the panels, the algorithm of the Fusion Solar platform calculated that carbon dioxide emissions were reduced by more than 305 tons, generating savings of nearly PLN 400,000. Energy efficiency is also dependent on automation and control of various types of installations. An interesting aspect in this area is hospital lighting. Ledification, i.e. the replacement of obsolete lighting with LED systems, contributes not only to significant energy savings, but also to the reduction of CO_2 emissions. An important factor is the quality and durability of led light sources. In the case of reputable fluorescent light sources, the lifetime is 16,000 h. The lifetime of LED sources is more than four times longer – about 70,000 h.

2.

Thermal modernization of medical facilities is by far the most common type of investment in the sector. The buildings of hospitals and other facilities are often from a bygone era, so they do not meet international standards for heat management. The European Environment Agency (EEA) indicated that heat will cause up to 120,000 premature deaths per year in the European Union by 2050, with external costs affecting the entire economy reaching EUR 150 billion (if appropriate preventive measures are not taken). However, studies of medical facilities indicate that more and more of them are investing in heat pump systems, upgrade of district heating substations and air handling units equipped with radiators, as well as replacement of window frames. Over the past eight years, heat consumption has been reduced by up to 50% in some hospitals, generating CO_2 emission savings of 1,000 tons per year. What is more, the use of the above solutions, which are designed to last for many years, reduces hospital maintenance costs, which is a major problem for both local governments and state authorities.

3.

Digitization of hospitals, i.e. technological transformation in such areas as document circulation, energy management or communication with patients. One of the key barriers to accessing health care services are socio-demographic conditions, which digitization can help reduce. The Lux Med Group processes some 40 million documents per year as part of its electronic processing of documents. Creating such a process eliminates the cost of printing and archiving and at the same time increases medical record accessibility to patients. With the advancement of technology, an increased use is made of artificial intelligence (AI), which

is capable of making independent decisions in management processes, thus contributing to the materialization of the idea that health depends not only on the quality of services, but also on the quality of the environment in which they are provided.

4.

Healthy food and hospital food service require extensive and rapid reform. As the researchers point out, existing regulations do not provide for mandatory patient nutrition consultations with a dietitian. This situation occurs in circumstances in which we are aware of the huge impact a properly managed diet has on a patient's health and recovery. Major changes are also needed in the area of supply chain and food quality. It would be prudent to formulate mandatory requirements for public procurement procedures that take into account high quality food sourced from regional and organic farming, which reduces the carbon footprint created by an extended supply chain.

5.

Sustainable medical equipment and waste management are certainly those elements which are often overlooked and neglected in medical facilities. Millions of tons of plastics and disposable instruments used during medical procedures are a scourge and one of the sector's biggest challenges. Each year, out of the nearly 100 billion tons of resources entering the market only 8.6% is recovered and recycled for reuse. The current consumption model is based on mass production of goods, quick sales, use of goods for a limited time, and subsequent disposal of products by the end user. These challenges are tackled by the circular model of resource management, which is based on four basic actions: Take – Make – Use – Reuse. This assumption is employed by, among others, Philips Healthcare, whose strategy provides for designing the life cycle of a product until its final disposal. A useful solution is also the purchase of refurbished equipment. Based on an example of a Philips product, such equipment, when restored to like-new condition and/or regenerated in rigorous processes, can produce savings of up to 25% compared to the same brand new system. A great challenge also comes from medical waste, which cannot be managed effectively due to the applicable regulations. One solution is to build thermal waste treatment facilities, but these, despite the high quality of filters used in such units, face complicated procedures and resistance from local communities, as well as unfavorable regulations at the international level. Therefore, the first and the most important step is down to minimizing waste generation as part of the sector's activities and applying the principles of circular economy.

6.

Sustainable hospital environment and clean air are elements whose absence is what we have become accustomed to. However, their role is invaluable in the process of implementing the idea of green hospitals. In addition, based on the current state of knowledge it is unquestionable that conscious use of gardens in hospital development is justified and necessary. Contact with nature, even in a passive way, helps reduce stress, relax, and evokes positive emotions. The positive effect of nature's influence manifests itself within just 3-5 minutes of observing plants, which has a measurable effect on improving wellbeing even in seriously ill patients. Groundbreaking research conducted in this area has proven that a green environment speeds up the recovery process and reduces the need for painkillers. Special attention should also be paid to air quality around hospitals and other medical facilities. Studies in London showed that despite the improved air quality in the city, all such facilities were located in areas that did not meet WHO standards. No similar studies are conducted

in Poland. However, the location of many facilities suggests that their areas also do not meet such standards.

How to holistically promote sustainable development of hospitals?

The efficiency of work and cooperation of healthcare professionals and the carbon footprint of hospital's technical infrastructure are influenced by sustainable workflows, i.e. efficient triage and queuing of patients, digitization of hospital records, planning and management of technology taking into account its entire life cycle (including the warranty and post-warranty period, the need to plan upgrades, improvement or extension projects).

An equally important aspect contributing to sustainability of hospitals involves the facility's logistics and procurement processes, which are a consequence of taking into account ergonomics at the design stage of new facilities or the enhancement of operational efficiency of existing hospitals through initiatives dedicated to lean and low-carbon hospital logistics.

The final element worth analyzing, including through audit projects, research and professional services, is sustainable infrastructure related to the management of lighting, heating, management of water and medical and non-medical equipment in the context of its stock and standardization.

In conclusion – a sustainable hospital is defined by sustainable workflows and collaboration, sustainable logistics, architecture and procurement processes, as well as sustainable infrastructure.

Legislative acts, such as the regulation of the European Parliament and of the EU Council on disclosure of information related to sustainable development in selected sectors of economy (SFDR) and the directive of the European Commission as regards corporate sustainability reporting (CSRD) will further stimulate the implementation of sustainability-related standards, including through reward mechanisms that will improve the competitiveness and attractiveness of entities making efforts towards sustainability.

Conclusions from the report indicate that there is still much to be done, and that our journey has just begun. However, the purpose of this issue and subsequent editions of the report is to trigger discussion and promote the implementation of viable solutions by sharing good practices and common experience of the business sector, science, NGOs and the practical knowledge of medical facilities.

Introduction to the report

Green Hospitals or, more broadly speaking, sustainable health care is a matter that is brought up in reflections on Poland's path to decarbonization too rarely. When we think about the implementation of UN's climate policy, whose objective is to minimize average global temperature rise and stop it before it reaches 1.5 degrees Celsius, or meeting the requirements set out in the RePower EU communication or the draft Fit for 55 directive, we tend to think about the transition in the energy sector. It is followed by transportation, urban development and other industries.

Meanwhile, the medical sector accounts for more than 4% of global carbon emissions. Health care, however, does not exist in isolation, but just like in the case of other industries, it involves a number of areas: technological and legislative shortcomings, financial issues or omissions – either intentional or resulting from lack of relevant education – that ultimately contribute to a gap in the process of preventing adverse climate change.

Implementation of the idea of Green Hospitals boils down to meeting the requirements of the Paris Agreement and the European Green Deal, which represent a commitment to reduce the effects of global warming, thus keeping the temperature rise below the 1.5°C, cut emissions by at least 55% by 2030, compared to 1990 levels, and make Europe the first net zero continent in terms of carbon emissions by 2050. However, in order to achieve the above goals, the sector should be analyzed holistically and, when examined thoroughly, areas that need immediate change should be identified, such as the sustainability of the supply chain, which accounts for more than 70% of the entire sector's greenhouse gas emissions. Looking from a broader perspective, we must also take into account the buildings of medical facilities and hospitals, which are in urgent need of renovation to improve their thermal efficiency and sensu largo their energy efficiency, which entails changes in methods of power supply and management of electrical power systems in such buildings.

A comprehensive look at Green Hospitals must take into account their location and surroundings, which should be conducive to recovery of patients and, indirectly, have a positive impact on air quality on hospital grounds and in those buildings themselves. An important factor is also the potential to improve management of everything that is used inside hospitals. This includes a wide range of inventory – starting from medical equipment, which should last for years, be user-friendly and reusable (unless changes are forced by technological advancement), and ending with the use of various types of digital solutions, such as artificial intelligence or cloud databases enabling more efficient and cost-effective management of document circulation.

Speaking of the management of hospitals and medical facilities, it is also important to remember about waste, the amount of which has increased dramatically as a result of the pandemic. Disposal of various types of waste and pharmaceuticals is an extremely broad topic and all the more important because in the current reality recovery of waste and its reuse is not only a challenge, but also a necessary process in the sector. In fact, the development of a Circular Economy requires relevant solutions not only in the production of high-energy fractions that can be used as fuel in the power industry, but also in the fertilizer sector, recycling and any other possible areas, that can replace rare-earth elements and hydrocarbons in the event of their shortage.

These initially outlined problems are discussed in more detail and illustrated using specific examples in this publication, and they will also be further addressed in subsequent issues of Green Hospitals. This is because the publication is not a one-time event that will solve the problem, but the beginning of a path that the healthcare sector in Poland has just embarked on, and it is our and your role to demonstrate our commitment to building a sustainable and ultimately low-carbon economy wherever possible.

Kamil Wyszkowski
Representative and Executive Director
of UN Global Compact Network Poland


GASTROENTÉROLOGIE
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II. The voice of business

I.
Green hospitals in practice

Will Clark
Executive Director,
Health Care Without Harm (HCWH) Europe

The healthcare sector sits at the intersection of contemporary environmental and public health challenges. As has become clearer in recent years, the activities of the sector contribute to the degradation of the natural environment, which in turn undermines human health. Crucially, however, the healthcare sector also holds many of the solutions to build a healthier planet that can support, preserve, and even improve our health.

Human health is intrinsically connected to the health of our natural environment. We've long understood that pollution and contamination of the air we breathe, the soil we grow our food in, and the water we drink all negatively impact our health. It is now recognised that the major environmental challenges we face, such as climate change, are serious threats to public health. Not only do the consequences affect our health directly, but they also severely undermine our ability to provide treatment – the healthcare sector is already on the front line and therefore must act.

Paradoxically, the healthcare sector itself is a major source of pollution and environmental harm. Healthcare activities release 4.4% of global emissions (4.7% in the EU) – making a significant contribution to climate change: if the healthcare sector were a country, it would be the fifth largest emitter on the planet. Decarbonising and greening the sector therefore holds huge potential for global carbon reduction targets.

It was in recognition of these issues that Health Care Without Harm was established, with a mission to create a more sustainable healthcare sector worldwide. But what does this mean in practice? What does a sustainable healthcare sector look like, and how do we create 'green hospitals'?

In Europe, we identify three intersecting priorities for building a sustainable healthcare sector, which are closely aligned with the EU's Green Deal. Firstly, addressing the impacts of climate change means decarbonising the sector, but also building more resilient healthcare systems that can adapt to a changing climate and its impact on infrastructure and communities. Secondly, by leveraging its economic significance (around 10% of GDP in Europe), healthcare systems can create demand for more sustainable products and services that integrate a circular economy model into the sector's operations. A focus on improving resource efficiency and phasing out single use products is essential to reduce waste and pollution across the value chain. And thirdly, the healthcare sector must take holistic action on the impacts of pharmaceuticals and their supply chains, addressing harmful emissions into the environment and crucially working to prevent and reduce antimicrobial resistance.
Putting all this into action means firstly acknowledging and measuring environmental impact at the healthcare facility level. Knowing where hospitals are on their journey can help them define long-term sustainability goals and articulate a strategy to achieve them.

For many hospitals this work can feel daunting at the outset, especially at a time of competing priorities and limited resources. It is important, however, for individual hospitals to recognise that they are not alone on their sustainability journey. The Global Green & Healthy Hospitals (GGHH) movement is continually growing in Europe, currently with 161 members from 24 countries, representing over 6,000 individual hospitals and healthcare providers, is coming together to take action on sustainability and learn from one another, dramatically accelerating shared common goals within the sector.

This movement of solidarity and exchange provides practical support, inspires action, and brings together a wide range of experts from many industries to bring about the green transformation of healthcare, as we have seen in this "Green Hospitals" report from Global Compact Network Poland.

The transformation of healthcare requires action at all levels within the sector, involving both clinical and non-clinical staff to change behaviour, systems, and products, all the way up to the most senior level. Executive and senior leader buy-in is essential to make a real lasting change - recognising not only the health benefits of action on sustainability, but also the moral case to act and the increasingly compelling business case that is being well demonstrated throughout the GGHH network. Investing in the skills, expertise, and technology to reduce the environmental impact of healthcare can bring immediate and ongoing financial returns for the sector.

Looking beyond the hospital walls, constructive engagement and collaboration with the supply chain will be fundamental in transforming the sector into a leader in the sustainability movement. Around two thirds of healthcare emissions originate from the procurement of goods and services, and so suppliers into the healthcare market also have a pivotal role to play. In collaborating on this report, Philips recognises the importance and potential of the healthcare sector's growing demand for sustainable products and services, and continues to provide leadership and innovation in meeting this demand.

The journey to a green and sustainable healthcare system is long and full of challenges, but hospitals and healthcare providers across Europe are stepping up. Whether they are just starting their sustainability journey or leading the charge, European healthcare providers are coming together to drive the sustainability agenda forward. This is a movement that has the potential to dramatically improve human and planetary health; it is also one that will surely only continue to grow.

Judy Njino
Executive Director, Global Compact Network Kenya

FOREWORD FROM EXECUTIVE DIRECTOR OF GLOBAL COMPACT NETWORK KENYA

As the demand for sustainability in all industries continues to grow, the healthcaresector has come under increased pressure to reduce its environmental impact. Hospitals play a crucial role in our society, and it is vital that they become more sustainable in order to reduce their environmental footprint and protect the planet for future generations.

It is clear that the business-as-usual approach will not be enough; we need to go ahead of the curve and do more than just treat symptoms of diseases, as this will allows us to preventatively advance the health of people and our planet.

There is an urgent call for hospitals to build resilient health systems that anticipate, respond, recover, and adapt to current and future climate-related shocks and stresses. In recent years, there has been a growing recognition of the need for sustainable healthcare practices on a global scale. Governments, healthcare institutions, non-governmental organizations and business entities across the supply chains are all playing a role in this transition, implementing a variety of initiatives aimed at reducing the sector's environmental impact.

One such institutions is Metropolitan Hospital Nairobi a signatory to the UN Global Compact Network Kenya. This report spotlights how the hospital has turned its commitment into action by digitizing its operation to minimize its environmental impact, adopting a circular economy model to manage e-waste and investing in energy management systems. These efforts not only benefit the environment, but also enhance the hospital's overall efficiency and quality of care provided to patients.

I would like to commend the work of the UN Global Compact Network Poland in publishing the first edition of the Green Hospital Report. This report presents an overview of the global sustainable healthcare sector, highlighting the challenges, opportunities and progress made within the industry. It also showcases best practice examples of innovative and successful initiatives from around the world, providing inspiration and guidance for other healthcare providers looking to adopt more sustainable practices.

The outcome of this report will be valuable for hospitals, policymakers, and other stakeholders looking to promote sustainable healthcare practices on a global scale.

We hope that this report will serve as a valuable resource for all those looking to implement similar initiatives and make a positive impact on the environment. Together, we can work towards creating a more sustainable healthcare system for all.

Dr. Ihor Kuzin
Deputy Minister of Health of Ukraine,
Chief State Sanitary Doctor of Ukraine

МІНІСТЕРСТВО ОХОРОНИ ЗДОРОВ'Я УКРАЇНИ

UKRAINE'S RESILIENCE AMIDST THE ONGOING WAR: A CASE FOR SUSTAINABLE HEALTHCARE

INTRODUCTION

Ukraine has faced a devastating war with Russia for over a year and a half, resulting in widespread destruction and suffering. Despite these challenges, Ukraine remains committed to maintaining essential healthcare services and promoting environmental sustainability. In this paper, we will highlight Ukraine's efforts in collaboration with the World Bank, focusing on the adoption of energy-efficient and climate-adaptive technologies under the Bank-funded projects.

UKRAINE'S HEALTHCARE CHALLENGES

The unprecedented war of Russia with Ukraine has taken a heavy toll on Ukraine's medical infrastructure. To date, 190 healthcare facilities have been completely destroyed, and 1,432 others have suffered damage. These facilities include maternity homes, hospitals, outpatient clinics, and PHC centers. Regions such as Kharkiv, Donetsk, Mykolaiv, Kyiv, and Chernihiv have borne the brunt of these attacks. Furthermore, 103 ambulances were damaged, 253 vehicles destroyed, and 125 ambulances seized, severely hampering the healthcare system's ability to respond effectively.

SUPPORT FROM THE WORLD BANK

The World Bank has been a steadfast partner for Ukraine, initiating crucial projects since 2015. Currently, Ukraine is benefitting from three major projects: "Improving Health in the Service of People," "Emergency Response to COVID-19 and Vaccination in Ukraine," and "Healthcare Enhancement and Life Saving" (HEAL Ukraine), with a combined health financing of $807.4 million. A central requirement for healthcare facilities participating in these projects is compliance with the World Bank's environmental and social policies, ensuring the mitigation of potential adverse risks and environmental impacts.

RESPONSIBLE MEDICAL WASTE MANAGEMENT

Ukraine acknowledges the importance of responsible medical waste management, considering the significant energy consumption and environmental impact of healthcare facilities. Consequently, the country has adopted rational approaches in alignment with national standards and World Bank policies. An analysis of epidemically hazardous medical waste generated during COVID-19 vaccination in 2021 led to crucial improvements in regulatory frameworks, equipment procurement for waste disinfection, and staff training.

Even in 2022, right after the invasion and when martial law had already been imposed, Ukraine distributed 4,654 special containers to PHC centers and hospitals for medical waste storage. In 2023, an ambitious project aims to equip healthcare facilities with sets for disinfecting medical waste, making them suitable for reuse. These initiatives not only enhance sustainability but also allow facilities to provide decontamination services to neighboring healthcare institutions. This year, the Ministry of Health also plans to commence training sessions on medical waste management for 1,200 specialists from PHC centers, inpatient healthcare facilities and regional disease control centers. These sessions will prepare them for the utilization of new waste decontamination equipment, promoting efficient and environmentally responsible practices.

GREEN ENERGY AND ENERGY EFFICIENCY

Under the HEAL Ukraine project, over 200 medical institutions will receive solar energy equipment, including panels, inverters, and batteries, to harness and store solar energy. This not only enhances energy independence but also ensures uninterrupted healthcare services during emergencies. Additionally, damaged healthcare facilities are encouraged to implement energy-efficient and alternative energy measures, thus reducing their environmental footprint. The HEAL Ukraine project will also provide 75 rural and remote facilities with electric vehicles to improve access to primary healthcare services. These vehicles are both cost-effective and environmentally friendly, producing no harmful carbon dioxide emissions. This pilot project is set for expansion based on its effectiveness.

The construction and renovation of facilities within the recovery support will adhere to the principles of climate-adaptive and energy-efficient technologies. The same applies to the procurement of medical equipment that will be organized through World Bank support.

Finally, support of the digital modernization of health systems and facilities, and investments in the development of telemedicine will help reduce the amounts of carbon and waste associated with the use of outdated technologies or travel.

CONCLUSION

Ukraine's healthcare system has demonstrated remarkable resilience in the face of Russia's full-scale invasion by embracing sustainability and environmental responsibility. Initiatives supported by the World Bank, such as the procurement of electric vehicles and solar panels, as well as the promotion of energy-efficient technologies, are pivotal steps towards a greener and more sustainable healthcare sector. Ukraine's unwavering commitment to environmental stewardship, even in challenging times, serves as a compelling case study for the proposed Green Hospitals report.

Ewa Pruszewicz-Sipińska, PhD, Architect,
Associate Professor at Poznań University of Technology
Agata Gawlak, PhD, Architect
Magda Matuszewska, PhD, Architect
Piotr Springer, MSc

Faculty of Architecture, Poznań University of Technology

REPORT ON GREEN HOSPITALS

INTRODUCTION

The Faculty of Architecture at Poznań University of Technology is currently conducting research in the field of architecture and urban planning, focused on designing healthcare facilities, including hospitals.

The research deals with functional and spatial solutions allowing to create quality space capable of positively affecting the treatment and recovery of patients, improving the comfort of their hospital stays and facilitating complex processes to optimize the work of medical staff. Hospitals are typically perceived as facilities tasked with accomplishing their primary mission, i.e. providing high quality medical services. Simultaneously, healthcare facilities typically consume large amounts of electricity. Hence, new concepts have been developed that aspire to transform hospitals not only into places designed with the welfare of their patients in mind, but also into environmentally friendly establishments. A change in the approach to designing hospitals is vital, as it may potentially offer measurable benefits for us to enjoy as a result of mitigated adverse environmental impact of hospital buildings.

HOSPITAL INFRASTRUCTURE IN POLAND

According to the data of the Central Statistical Office, there are 898 hospitals operating in Poland. All these hospitals handle more than 200 patients per bed [annually], and the total number of hospital beds available in Poland is estimated at 167,000 (Central Statistical Office, 2020). Nearly every other state-run hospital in Poland is located in a building erected in the 1950s. Therefore, thermal modernisation projects are one of the top priorities in terms of improving energy efficiency of healthcare facilities, since the original engineering solutions they rely on are obsolete in comparison with state-of-the-art technologies applied in new hospital buildings. High consumption of water by the healthcare sector is another environmental challenge. The standards applicable in Poland consider hospitals to be the largest consumers of water (per user) when compared with other types of commercial buildings (according to current estimates, average daily consumption of water per one hospital bed is 650 dm3 – while one bed in a 3-star hotel consumes, on average, 100 dm3 of water per day). Thus, a search for water management optimizing solutions seems to be fully justified. Optimisation of energy management (reduction of consumption levels, use of alternative energy sources), sustainable water management or even sustainable catering and suitable landscaping practices may bring about measurable benefits, in terms of both climate protection and cost efficiency. Air quality is strictly linked with the health condition of the entire population and contributes to a wide range of diseases worldwide. This, in turn, translates into increased demand for medical services provided by hospitals. The growing number of hospitalised patients increases energy consumption even further.

ENVIRONMENTALLY FRIENDLY ACTIVITIES UNDERTAKEN IN THE HEALTHCARE SECTOR

A whole range of initiatives is being undertaken in Poland to adapt the infrastructure of public utility facilities to the challenges brought about by climate change. It is the **National Fund for Environmental Protection and Water**

Management that is responsible, in Poland, for financial coordination of undertakings pursued on the national scale. The Fund has been subsidizing, since 2017, sustainable investments in hospitals, allocating EU and state budget funds for that specific purpose (such investments include: thermal modernisation projects improving the heat insulation of walls and ceilings, modernization of heating, ventilation, air-conditioning and power supply systems, transition to renewable sources of energy in hospitals; introduction of hospital energy management systems). In total, the Fund has invested PLN 199 million in healthcare infrastructure. The on-going analysis of the effects of the aforementioned investment projects, subsidised by the National Fund for Environmental Protection and Water Management, has also identified additional advantages in the form of energy generated from renewable sources: 0.06 MWt of heat and 0.11 Mwe of electricity. Furthermore, total heating-related savings amount to approx. 52873 GJ per year, and electricity savings equal approx. 1038 MWh per year. It is estimated that modernised hospitals have reduced greenhouse gas emissions by approx. 4662 tons of CO_2 equivalent.

GOOD MODELS. POLAND'S FIRST GREEN HOSPITAL – A MEMBER OF THE GLOBAL GREEN AND HEALTHY HOSPITALS NETWORK

The Global Green and Healthy Hospitals network is the largest organization affiliating green hospitals. More than 1,500 of its members from 75 countries represent the interests of over 60,000 hospitals. The network offers a diverse array of programs intended for the implementation of energy saving solutions in hospitals that aim to reduce their environmental impact as well as for the promotion of knowledge and educational tools.

The idea of green hospitals is rather new in Poland. Nevertheless, it is being slowly and regularly implemented at various levels. A particular emphasis needs to be placed on local initiatives of local government entities and recommendations requiring that environmentally friendly solutions be relied upon in newly designed and modernised facilities. Sustainability-conscious policies and multi-layered efforts have enabled the **Regional Specialised Tuberculosis and Lung Diseas Healthcare Centre in Wolica** to join the Global Green and Healthy Hospitals network. It is the first green hospital in Poland and the only one in Central and Eastern Europe to have achieved such a feat. One of the hospital's wings in which patients who have recovered from COVID-19 are undergoing rehabilitation has been erected in accordance with the so-called eco building system allowing to fully eliminate carbon dioxide emissions[1].

The aforementioned hospital has been provided with alternative sources of energy: "*The building is made of non-concrete materials. It is energy-efficient, has a mechanical ventilation and heat recovery system and relies on environmentally friendly materials, which translates into a reduced carbon footprint, decreased amount of construction waste generated, lower water consumption and reduced emissions of dust or other air pollutants.*" [2]

SOFT LANDSCAPING IN THE VICINITY OF HOSPITALS

The way the land surrounding hospital buildings is developed is often an underappreciated factor in our efforts for ensuring the high quality of space around us and for caring for the environment. Therapeutic gardens – with their primary purpose being to foster the recovery process – are also capable of cooling and filtering the air, thus improving the microclimate. The surface of soft landscaped areas may be extended by designing green roofs. Such solutions are rarely part of modernization projects. However, they are becoming increasingly popular in newly designed hospitals – this is the case, for instance, at the new complex of the **Regional Hospital in Toruń** which also takes advantage of solar thermal collectors and solar panels, LED lighting sources, a robot sorting drugs in the hospital's pharmacy and a rainwater recycling system flushing toilets. A green roof increases the surface of a biologically active area and ensures additional cooling of the building's top floor in summer, simultaneously insulating it thermally in winter[3].

1 https://politykazdrowotna.com/artykul/polskie-szpitale-tez-moga-byc-ekologiczne/823418.
2 https://www.rp.pl/obszary-medyczne/art36052501-szpital-w-wolicy-pionierem-w-wykorzystaniu-zielonej-energii-w-obiektach--medycznych-w-polsce.
3 https://www.politykazdrowotna.com/83022,polskie-szpitale-tez-moga-byc-ekologiczne.

THE FIRST HOSPITAL WITH GREEN OXYGEN

Oxygen is considered green if its generation process relies fully on renewable energy sources. Such a solution has been implemented at the **Pro-familia Hospital in Rzeszów** and allows it to reduce carbon dioxide emissions by more than 60,000 tons. This represents an equivalent of an annual carbon footprint generated by more than 7,000 households. The solution is not frequently used in Polish hospitals yet, but it is highly recommended, as it offers major energy consumption savings[4].

THERMAL MODERNISATION OF HOSPITALS

Thermal modernisation projects are an increasingly popular solution improving thermal efficiency of hospital buildings. They contribute to more efficient use of natural energy sources and reduce greenhouse gas emissions. The buildings of many hospitals operating in Poland were erected in the 1960s and 1970s, with the use of the then-prevailing, energy inefficient technologies. Thermal modernisation significantly reduces energy losses, increases thermal comfort and boosts the standard of healthcare facilities. Thermal modernisation projects also offer a high potential in terms of improving the appearance of buildings, providing an opportunity to redesign or upgrade their facades. However, thermal modernisation of historical buildings in which hospitals are often located poses a significant challenge, as in such a case renovation of the building's interior is required as well.

At present, large-scale modernisation works are pending at the **University Hospital in Zielona Góra**. Thermal modernisation has also increased energy efficiency of the **Regional Specialist Hospital No. 2 in Jastrzębie-Zdrój.** The modernisation works included: thermal insulation of external walls of the buildings, roof repairs, as well as replacement of window and door frames. Other examples include thermal modernisation of **Klara Jelska Specialist Lung Disease Hospital in Zakopane**, subsidized by the National Fund for Environmental Protection and Water Management, or two other projects implemented at the **Regional Specialist Hospital No. 2 in Jastrzębie-Zdrój.**

With the support of an architect, thermal modernisation of healthcare facilities may also include optimization and re-designing of the functional layout of the building in order to move beds to southern portions of buildings that are more exposed to sunlight. Thermal modernisation includes also architectural design work. Even if such work requires that high costs be incurred, hospitals are usually eligible for subsidies, as the modernisation process renders measurable benefits. This increasingly often motivates hospitals to modernize their buildings.

ALTERNATIVE SOURCES OF ENERGY

Cost efficiency is the primary reason why hospitals are willing to switch to alternative sources of energy. Mitigation of the adverse environmental impact is an added value of such a transition. Heat pumps are becoming a popular solution used in hospitals. The pollute the environment to a much lesser extent than traditional solutions, simultaneously reducing energy consumption by 80%, eliminating carbon dioxide emissions and, thus, failing to contribute to the greenhouse effect. Additionally, they can be powered from alternative energy sources or run without using electricity.

The Specialist Lung Disease Hospital in Zakopane is currently transitioning to heat pump technology (a 36 kW air-to-water heat pump will be installed there to support the heat exchangers currently in operation). Additionally, the project envisages thermal modernisation of all of the hospital's buildings in which a mechanical ventilation system with a heat recovery functionality (with an air-to--air handling unit) will be installed.

As regards the **Regional Specialist Hospital No. 2 in Jastrzębie-Zdrój**, the EU funds and subsidies from the budget of the Silesian Region have been earmarked for the development of a highly-efficient cogeneration system intended to generate heat, hot water and electricity in order to partially satisfy the hospital's needs. The new system will be highly reliable, which is of particular importance for healthcare facilities. Increased cost efficiency of electricity produced and the reduced carbon footprint resulting from low CO_2 emissions are the added values of the project.

Solar panels are another solution that is used in hospitals on an increasingly frequent basis. The number of hospitals installing solar panels is rising. Solar panels usually serve as a supplementary source of energy, but they generate significant cost savings, reduce CO_2 emissions and provide energy security. In the case of hospitals consuming large amounts of energy (up to several thousand MWh per day), savings of several dozen per cent translate

4 https://www.pro-familia.pl/pl/31-o-nas/471-aktualnosci/2418-pro-familia-pierwszym-szpitalem-w-polsce-z-zielonym-tlenem.html.
5 https://wss2.pl/czytaj.php?id=433.

into a significant cost reduction and allow to reduce environmental pollution. Because a wide range of subsidies is available for investments of this type, many hospitals have recently decided to modernize their energy supply systems, simultaneously cutting their operating costs and reducing CO_2 emissions. These include, inter alia, the following: **Independent Clinical Hospital No. 1 of the Pomeranian Medical University in Szczecin** where solar panels were installed on the roofs of 11 buildings, **Medical Centre in Pleszew, Military Clinical Hospital in Wrocław, Prof. E. Michałowski Specialist Hospital in Katowice** or **Prof. Tadeusz Bilikiewicz Regional Psychiatric Hospital in Gdańsk.** Many hospitals also rely on much simpler energy saving solutions, such as LED light sources replacing more energy-intensive fluorescent tubes.

DIGITIZATION IN HOSPITALS

Digitization effectively increases the efficiency of hospital management processes, optimizing the consumption of energy as well. Precise monitoring systems allow to conduct in-depth analyses and contribute to optimizing energy consumption at every stage of the process[6].

Changes facilitating energy efficiency are also implemented in non-state (private) healthcare facilities. **The Private Hospital in Zamość** is planning to introduce a modern heat management system. The project includes the installation of temperature sensors enabling the temperature inside the hospital's rooms to be controlled remotely. The hospital is also planning to replace the air-conditioning sysem used in the operating theatre with the one equipped with a heat recovery unit[7].

There are also other sustainable solutions that the hospitals can rely on, for example those that help reduce the amount of paper documentation produced (**Electronic Medical Records System,** Guided Surgery System or Patient Tracking System). Increased efficiency of operating theatres generates additional energy savings. The

6 https://se-news.prowly.com/105173-inteligentne-systemy-ecostruxure-wspieraja-szpitale-w-sytuacjach-kryzysowych.
7 https://roztocze.net/pl/694_spoleczenstwo_i_patriotyzm/340217_energooszczedny-szpital.html.

Managed Equipment Service offers another opportunity, enabling hospitals to organize work more efficiently, thus contributing to achieving measurable savings and indirectly increasing energy efficiency. An efficient approach to operating medical equipment entails taking advantage of periodic inspections, warranties, low-cost replacements, compatibility or, finally, built-in energy saving solutions. Waste management constitutes an important element of the process of managing the operation of healthcare facilities and, as such, requires a suitable approach. Emissions of pollutants from medicinal products and medical waste are a worldwide problem. Research shows that high concentrations of medications are observed in water all over the world, and WHO has identified resistance to drugs and antibiotics as another potential pandemic. In Poland, 44,000 tons of medical waste are generated each year. 90% of that waste is of the hazardous and infectious variety. According to estimates, one hospital bed generates, on average, from 1 to 1.5 kg of medical waste per day. Modern technologies harnessed by hospitals may effectively reduce the volume of such waste and the frequency of its disposal. **Press containers/compactors** purchased by the Invasive Medicine Centre at the **University Clinical Hospital** are one of the potential solutions here[8].

FURTHER CHANGES

Hospitals made from recyclables?

Will this ever be possible? Perhaps not on a large scale, perhaps not as a systemic and commonplace solution, but such an approach is feasible. We can observe new alternative solutions developed in response to the increasing demand for hospital services and the need to protect the environment. Arthur Huang, a Taiwanese structural engineer and architect, has created a hospital ward (Modular Adaptable Convertible - MAC) ward made from trash. He used waste, namely mixed rice husks, processed DVD records and LED lenses. By experimenting with various types of waste (over 1,200 varieties), including medical waste created in autoclaves, he came up with alternative solutions for building and finishing materials. Walls of the MAC hospital are finished with panels with a 90% content of recycled aluminum and are insulated with reused polyester. To accommodate Covid-19 patients, a hospital in Taipei was extended a 98-bed ward made of such materials. Due to the fact that zero-waste technologies have been relied upon in the construction process, the hospital is mobile and can be erected within 24 hours. The design, developed in response to the need to efficiently adapt healthcare facilities to the increased demand for hospital beds and to erect temporary hospital wards during the pandemic, clearly shows the direction of development for hospitals and other healthcare facilities in the future.

In accordance with the current architectural trends, hospitals of the future should be fully sustainable, contributing to the protection of the environment as well as facilitating water and energy efficiency by relying on renewable energy sources and recyclable materials. Strategies adopted by sustainable healthcare facilities have been the subject matter of various certification systems, such as LEED 2009 for Healthcare, or Living Building Challenge. Other green building certification systems, such as BREEAM, WELL, DGNB or HQE, may also set the direction of change in order to ensure high quality hospital interiors facilitating the recovery of patients.

Hospitals may also be the sources of energy, thus becoming important links in transitioning energy supply systems of entire towns, regions or countries.
"*Dispersed sources of energy will also play a crucial role in ensuring energy security in areas where energy infrastructure is poorly developed.*" [9]

Hospitals need to ensure on-going provision of medical services, but we may choose to render such services with due care for the environment, by applying suitable solutions facilitating the transition of hospitals into truly green buildings.

8 https://www.politykazdrowotna.com/83022,polskie-szpitale-tez-moga-byc-ekologiczne.
9 POLSKA NET-ZERO 2050: Podręcznik Transformacji Energetycznej dla Samorządów - Energy Transformation Guide for Local Governments.

Andrzej Jeżyk, MSc, Eng

Emilia Fikus-Kuźnicka, MSc

Provincial Complex of Healthcare Institutions Specializing in Lung Diseases and Tuberculosis in Wolica (Poland)

Sławomir Wysocki, General Manager

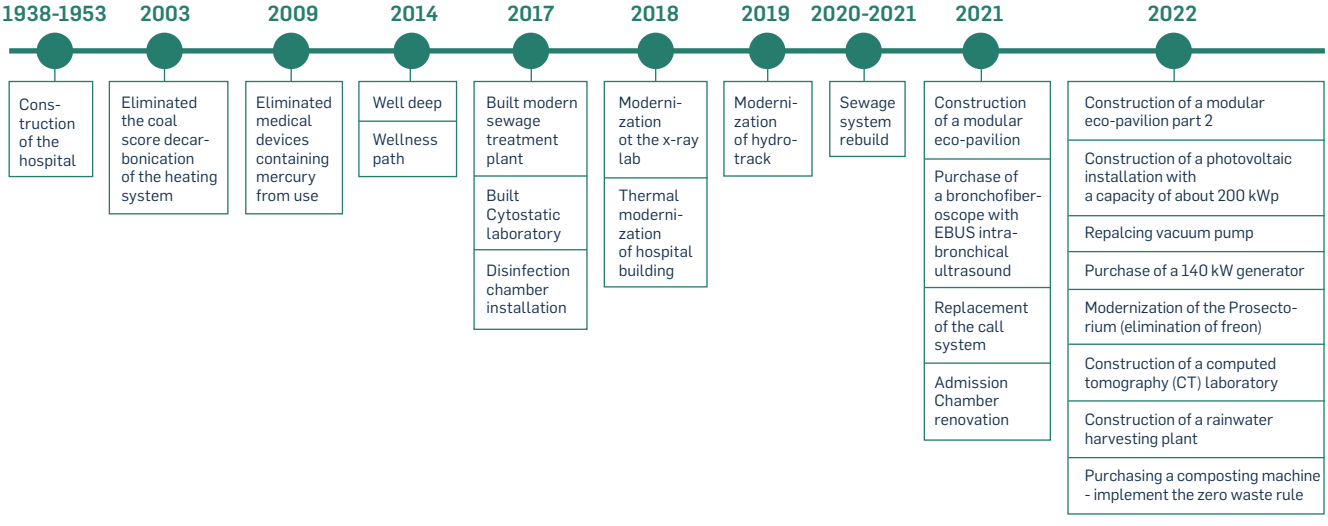
TRENDS AND ACTIONS TAKEN BY THE PROVINCIAL SPECIALIST COMPLEX OF HEALTHCARE INSTITUTIONS SPECIALIZING IN LUNG DISEASES AND TUBERCULOSIS IN WOLICA (POLAND) TO IMPLEMENT THE IDEA OF GREEN HOSPITALS

GREEN HOSPITALS - HOW TO CREATE AN EFFECTIVE HEALTH PROTECTION SYSTEM AND IMPLEMENT THE "DO NOT HARM FIRST" PRINCIPLE. HEALTH SECTOR'S ROLES AND RESPONSIBILITIES IN THE SOCIETY

The natural environment is an inseparable part of the functioning of the hospital in Wolica, directly influencing its existence and further development. Planet Earth, on the one hand, provides us with the resources that are necessary for rendering medical services. On the other hand, it is the recipient of any resulting pollution. Although a hospital is first and foremost a place where patients are treated, the effectiveness of and the ability to provide health services does not depend solely on the knowledge, commitment and skills of the medical staff. These elements must be supported by appropriate premises and technical conditions for performing diagnostic procedures, offering therapies and rendering rehabilitation services. From the technical point of view, the treatment process requires buildings, power systems, installations, medical equipment and other technical devices. Efficient performance of the hospital's core tasks, combined with conscious activities involving sustainable management of infrastructures, water, waste and other products, while monitoring the amount of waste generated and using technologies based on the rational use of resources, is reflected in the high quality of the medical services it renders.

With these ideas in mind, Slawomir Wysocki, the hospital's General Director, applied, in 2021, to include Provincial Complex of Healthcare Institutions Specializing in Lung Diseases and Tuberculosis in Wolica in the network of green hospitals. In the application form, we presented the hospital's achievements to date in terms of sustainable development, the investments made so far to reduce CO_2 emissions, undertakings aiming to introduce rational water and sewage management practices, as well as plans for the future, described in more detail in the subsequent section. Sustainability and climate protection have been at the heart of our activities for over a decade now. Year after year, we have been pursuing those goals by investing and changing the way our hospital operates. We have consciously faced the climate change challenge and are a proud member of the network of Global Green and Healthy Hospitals. Drawing on the experience of our experienced colleagues from GGHH and WHO, we continue to promote public health while reducing our environmental impact. We aim to be as carbon neutral as possible, and to increase the share of renewable energy in our operations.

Figure 1.
Investments made in recent years



With the above kept in mind, a team tasked with implementing eco-solutions, known as the Main Team, was established within the hospital's organizational structure. It acts in the capacity of a body advising the General Manager of the Clinical Lung Diseases and Tuberculosis Hospital in Wolica. Several focus groups have been appointed as well. These deal with the following issues: Health Care of Workers; Infrastructure, Technology, Products,

Water, Wastewater and Medical Waste Management; Energy; Pharmaceuticals; International Relations and Education. All staff members participating in the process of creating a green hospital play an important role in building mechanisms towards a climate-neutral facility. Based on reports on the actions taken by each team, we review the path taken on a quarterly basis. The core team and the General Manager, as well as the managers of each organizational unit, including the Deputy Operations Manager and the Deputy Medical Treatment Manager, review climate-related issues of strategic importance, including action plans, risk management plans and sustainability budgets, identifying climate-related opportunities. This gives us the opportunity to identify critical risks at an early stage and review progress in implementing initiatives taken. Such an approach also allows us to manage the inherent risks by responding, in a timely manner, to climate-related threats. In parallel, we seek funding opportunities for the planned projects and implement interim (alternative) solutions. Climate-related objectives and programs are embedded in our organization and in the manner we operate. This is evidenced by the following:

1. we place a particular emphasis on suitable procedures while preparing cytostatic preparations and managing waste. Cytostatic drugs are prepared in a purpose-built laboratory that complies with the strictest epidemiological and sanitary standards. The separation of rooms allows for safe production of individual doses of cytostatic preparations for in-patient and out-patient procedures. The laboratory is equipped with a chamber intended for preparation of cytostatic drug solutions under aseptic conditions;
2. we have completely given up the use of medical equipment containing mercury. Mercury thermometers have been replaced with electronic thermometers, and mercury blood pressure gauges have been replaced with mercury-free devices (electronic or mechanical, with dial gauges). We have thus contributed to reducing the amount of mercury emitted into the environment, including in the form of heavy metals polluting the air, which directly contributes to the protection of the environment and improves the quality of life;
3. we do not have a central sterilization room and rely on autoclaving. The equipment used in our hospital (mostly for bronchoscopy or pleural cavity drainage) is sterilized with the use of the following agents: AZTECA-AC-470, AZTECA-AC-470. The hospital has also concluded a contract for sterilizing thermolabile equipment with the Ludwik Perzyna Regional Complex Hospital in Kalisz;
4. we use laundry services provided by authorized and certified entities only. They use, in their daily operations, only those washing agents which are permitted on the Polish market and have been awarded with proper approvals or positive opinions issued by the National Institute of Hygiene or similar organizations;
5. when managing waste, we cooperate only with those companies that are licensed to transport hazardous medical waste to incineration facilities;
6. in order to minimize the risk of undesired events, we have integrated our fire alarm system with the control station of the State Fire Brigade in Kalisz. This ensures short response times, even in the event of a delayed reaction by the hospital's staff;
7. we allow our patients to rehabilitate in the open. We have constructed a health path which directly improves the effectiveness of the rehabilitation process;
8. we check the technical condition of our equipment on a daily basis, undertake current repairs, assess the risk of emergencies, failures and test the quality of wastewater;
9. we eliminate paper consumption, striving for the highest possible degree of digitization in the exchange of information between individual units;
10. we implement a procurement policy that is based on pro-environmental and pro-innovation policies;
11. we engage employees in social health programs, e.g. vaccinations against hepatitis, aimed at improving the health of the local community, in particular related to minimizing the risk of developing civilization diseases;
12. we organize preventive campaigns and health picnics for the local community;
13. we establish cooperation with other hospitals from Poland and abroad, local government units, educational institutions and NGOs in order to develop the so-called good emergency practices (including those relied upon to respond to climate crisis);
14. we combine our environmental activities with the economic management of specific units (by reducing the costs of maintenance of technical infrastructure).
15. we rely on an IT infrastructure that guarantees the cyber security of the hospital. We have implemented appropriate procedures allowing us to respond to potential attacks.

In addition to our statutory activities which are, obviously, of paramount importance, we have adopted the principle of "first do no harm" as the foundation of our development. We recognize, however, the need to coordinate internationally and to introduce fundamental changes to the manner in which medical facilities are managed. As a member of the Global Green and Healthy Hospitals initiative, we are ready to play our part and take meaningful action. We feel responsible to share the knowledge amassed during our climate journey. Although we are a new member of the organization, we decided to organize, in the first year of our membership, the first international conference in Poland focusing on the role of green hospitals in combating climate change, combined with a presentation of good practices applied by hospitals in Europe (1-2 June 2022). The aim of the conference was to draw attention to climate change and to highlight the potential methods preventing its advancement through a comprehensive range of solutions (technological, environmental, economic and social) that can be implemented in healthcare institutions. We aim to integrate the medical and local government communities and to involve companies that promote sustainable development and consider environmental protection a priority in shaping their product policies. We emphasize the need to learn from each other. Working with partners who have similar strategic goals is a source of great inspiration and allows us to establish contacts, taking action faster and on a larger scale.

DIGITIZATION AND THE LATEST TECHNOLOGIES FOR SUSTAINABLE HOSPITALS. MODERN AND ENVIRONMENTALLY FRIENDLY SOLUTIONS AND HOSPITAL EQUIPMENT

Our hospital was built in the 1950s. After 30 years, an additional wing was added to the building. Gradually, and to the extent our budget allows, we have been modernizing the facility, bringing it up to European standards. Over the past few years, thanks to efficient management, we have made enormous progress in equipping and adapting the facility to the needs of patients and staff. The potential effects of climate change are a challenge for both doctors and management, with the key emphasis placed on ensuring the stability and continuity of the hospital's operations in the short, medium and long term. The transition to a low-carbon economy creates opportunities for hospitals allowing them to harness technological innovations. Below are selected examples of modern and environmentally friendly solutions used in Wolica, as well as innovative medical products used, inter alia, at the Rehabilitation Ward and the Therapeutic Diagnostics Department.

Since its establishment, the hospital has faced problems with sewage disposal. The majority of wastewater was discharged directly into the soil. In 2017, a fully modern sewage treatment plant was built, allowing us to maintain proper sanitary and hygienic conditions and discharge sewage into the municipal sewage system and then into the collector pipe in Kalisz. The wastewater is disinfected on a regular basis. In addition, in 2021 the sewage system connecting the main building with the sewage treatment plant was rebuilt and its capacity increased. These investments allowed us to minimize the risk of environmental pollution. The quality of treated wastewater meets EU standards related to the content of hazardous phosphorus and nitrogen compounds.

Over the next four years, thanks to the money from the Voivodeship Marshall Office, all hospital wards will be modernized. This year (2022), we drew up the project's documentation. Our intention is to create an institution which sensibly takes advantage of the natural environment. The project assumes, inter alia, modernization and replacement of the technical infrastructure of specific wards, improvement of the patients' living conditions, introduction of energy-saving solutions (including those preventing the use of air conditioning when the windows are open, automation of the ventilation system), reducing water consumption (installation of water-saving toilets and water aerating taps), raising the functional standard of and improving the microclimate in the entire building by reducing emissions of harmful substances (including carbon dioxide) into the environment by lowering the amount of energy and water consumed by the hospital after modernization. To date, the Emergency Room's waiting area, the Microbiology Department and the clean and dirty linen storerooms have been fully refurbished.

The most prevalent civilization diseases in Poland include malignant lung cancer, laryngeal cancer, chronic obstructive pulmonary disease (COPD) and asthma. Not without significance are also the effects of the SARS-Cov-2 pandemic that began more than two years ago. The hospital in Wolica has responded to these threats by expanding and improving access to pulmonological rehabilitation of patients suffering from complications after the COVID-19 outbreak. Originally, we assumed that the hospital would be expanded (construction of an additional floor) using traditional building technologies, but due to the availability of a whole range of modern

construction materials and technologies complying with the principles of sustainable development, we decided to build a new Pulmonary Rehabilitation Ward using the modular technology. As a result, we built a well-insulated, airtight facility using materials that do not pose any harm to the environment, translating into a reduced carbon footprint. The fact that the majority of the project was implemented outside the hospital's premises allowed use reduce the amount of construction waste created, with a simultaneous reduction in the quantity of water consumed, as well as dust and other pollutants emitted into the atmosphere. In addition, chosen modular technology we have opted for complies with the principle of a circular economy, meaning that the building may be dismantled and its recyclable elements may be reused. The optimization of heating and ventilation systems (introduction of a heat recovery system) saves energy and protects the environment. The ejection units installed in the Aerosol Therapy Laboratory are another innovative solution we were particularly proud of. As many as four exhaust systems have been designed to eject the air from the room (separately for each of the inhalation stations). They consist of ventilation ducts connected directly to the inhalers' ejection stubs and roof ejectors. Three systems (WW3, WW4 and WW5) serve the inhalation stands for patients without infectious diseases, and one system (WW6) caters for the needs of those suffering from such illnesses. Air is transported via circular SPIRO type ducts. A bleed flap is installed in the external wall of the inhalation room removing the excess of supplied air outside the building when the inhalers are not in use. When the inhalation station for patients with infectious diseases is in use, the air supply to the room is cut off by a throttle valve with an actuator. Such a solution creates negative pressure in the room, compared with adjacent rooms. This innovative pressure differential system makes it possible to control the amount of air distributed and ensures the highest degree of protection.

The modular building described earlier was constructed in 100 days. Prefabrication of the individual elements in an external factory eliminated the discomfort associated with a traditional construction site located on the premises of an active medical facility, and allowed to complete the project in a short period of time while meeting budget targets. Our role was limited solely to supervising the construction process and managing the investment's logistical side. Images and videos from the project's execution phase are available on the hospital's social media sites. We encourage you to became acquainted with the materials. We are proud to have pursued the first investment of this type in this part of Wielkopolska region and the only one in Poland which has been completed in such a short period of time. The pioneering technological solutions are supplemented by carefully selected medical equipment. In addition to medical devices required under applicable legislation, we are one of the few facilities in this part of Poland to have, at our disposal, the following:

1. A Wellsystem dry hydromassage bed. The bed, offering a water massage and a heat therapy in one, creates a pleasant feeling of relaxation without the need to remove the patient's clothes. The unique combination of three elements - heat, pressure and water – makes this therapy highly effective. Water jets moving under the mattress generate pressure and heat reaching the deepest tissue layers and completely relaxing the body, thus creating an excellent starting point for additional treatments administered by a physiotherapist;
2. NuStep T4R functional training and whole-body activation device, allowing users of all fitness levels to engage in physical exercise. It activates both lower and upper body parts, creating holistic training routine that strengthens the muscles and improves the physical condition of people undergoing rehabilitation;
3. A modern Etius apparatus offering a combination of ultrasound and electro therapies, designed for administering treatments relying on a wide range of bipolar and unipolar currents. It allows the patients to undergo ultrasound therapy and phonophoresis, as well as treatments harnessing a combination of both of those techniques (electrophonophoresis);
4. A PhysioGo.Lite laser therapy device intended for visible light (660 nm wavelength) and invisible light (808 nm wavelength) laser therapies. The Astar low-energy laser offers three fully independent treatment channels whose beams may be focused on a single point of the body, may operate in the scanning mode or may use shower-like applicators;
5. A modern Sollux Lumina V5.0 lamp for infrared irradiation using IR-A and IR-B band rays, equipped with suitable filters, an electronic time controller with a brightness adjustment functionality and a controller for setting brightness levels / time sequences required in a given treatment;
6. A vibration massager relying on an intermittent electrostatic field generated, by the DEEP OSCILLATION device, between the applicator and the patient's tissues. During the procedure, thanks to the electrostatic forces created, the patient's tissues are pulled and then released with a selected frequency (5-250 Hz). Unlike other therapies, deep oscillation penetrates all tissue layers to a depth of 8 cm (skin, connective tissue, subcutaneous fat, muscles,

blood and lymphatic vessels). The effect of deep oscillation has been clinically proven.

When purchasing our equipment, we followed the principles of sustainable development. When choosing specific suppliers, we were guided by the quality of the products they offered and we specified, in the terms of reference, those product features that were of particular importance to us. While describing the medical equipment the hospital in Wolica is proud of, we cannot fail to mention our fiber bronchoscope with an EBUS intra-bronchial ultrasound module (acquired in 2021). This modern device makes it possible to perform examinations and take samples for histopathological tests. Previously, our patients were forced to undergo EBUS checks in Poznań, 150 km from Wolica. The lack of suitable equipment not only limited access to diagnostic tests, hindered the treatment process and caused stress and discomfort for patients, but also indirectly contributed to an increase in emissions, as the patients were required to travel to a facility equipped with the suitable medical apparatus. On-site diagnostic capabilities help reduce CO_2 emissions by limiting the number of journeys made. Today, we perform approximately 90 bronchoscopy procedures per month, with 40 of them, on average, performed using EBUS. The ability to assess tissues located deep within the bronchial tree is one of the greatest advantages of EBUS examinations. A classic fiber bronchoscopy only allows to assess the mucous membrane of the tracheal wall, bronchi and vocal cord structures. The flexible design of the fiber bronchoscope makes it easy to introduce it into the bronchial tree. The device is equipped with a miniature camera and an ultrasound head (with the diameter of less than 3 mm) enabling the operator to precisely assess the condition of the respiratory system, mediastinal organs and blood vessels located in this area. During the EBUS examination, a fine needle aspiration biopsy (BAC) can be performed as well.

Fiber bronchoscopy with endobronchial ultrasound is a diagnostic method offering an alternative to mediastinoscopy or thoracoscopy. Both latter methods involve a surgical procedure and are therefore associated with a higher risk level. We are proud of the fact that we have acquired this device, as it places our institution on a par with large pulmonology centers in Poznań or Łódź. We are already training all doctors who know how to perform EBUS, teaching them to perform preliminary 'internal' diagnostic procedures as well. We are thinking of opening a cytology laboratory and working online with doctors and histopathology specialists to evaluate the material collected for histopathological tests. The digital solutions available these days make it possible. The main objective is to reduce the waiting time for the final result of the examination – both for the patient and for the doctor planning further treatment which should be offered as soon as practicable. Bronchoscopy, along with X-ray and CT scanning, is the gold standard for diagnosing pulmonary diseases in Poland. In 2018, we modernized the X-ray laboratory. The purchase of a modern digital X-ray machine made it possible to reduce radiation doses and (as in the case of EBUS) reduce environmental pollution by hazardous waste resulting from the photochemical processing of images. Thanks to the digitization of processes, images are now stored on digital media.

This year (2022), we began the construction of a corrido connecting the existing hospital building with a newly erected modular pavilion which will house, inter alia, a CT scanning lab. e. Our own CT scanning laboratory will increase the patients' access to lung disease diagnostic procedures, thus facilitating the selection of a suitable treatment method and reducing the time spent waiting for commencing therapy. A modern CT scanner will make it possible to reduce the frequency of ambulance trips required to transport patients to other centers for checks, thus reducing the environmental footprint of the diagnostic process. By eliminating photochemical processing of images, we will reduce environmental pollution with hazardous waste generated in the diagnostic process, as tomography-based procedure, like all modern imaging techniques, allows to save examination results on computer media.

GREEN ENERGY FOR HOSPITALS + ENERGY EFFICIENCY

A systematic improvement of energy efficiency has been, for several years now, one of the hospital's priorities, both in terms of energy efficiency of buildings and energy-intensive equipment and processes. Such an approach stemmed from the fact that energy efficiency improvements lead to significant financial benefits from lower energy demand and increased efficiency associated with the technologies used.

In 2019, a project involving thermal modernization of the hospital's buildings was completed, with the majority of the funding provided by the EU. In order to improve the comfort of the facilities located on the premises and to reduce the cost of heating, the decision was made to perform thermal modernization of all facilities, including the main hospital building, the hospital pharmacy and the administration building. Ceilings, roofs, exterior walls and underground surfaces of the walls (basement walls) were insulated, ventilators were installed, and doors were replaced with energy-efficient ones. In addition, windows were replaced in the administration building, and a heat pump supplying hot water was installed. The project has resulted in the following: a reduction in carbon dioxide emissions by 142.27 t CO_2/year, improved thermal comfort in the hospital, administration and pharmacy buildings, and reduced costs associated with heating.

2022 is a year in which numerous projects involving modernization of hospital buildings and the replacement of old equipment with new-generation devices are in progress. Such investments include:

1. **Construction of a photovoltaic farm.** In the long term, the PV installation will contribute significantly to reducing emissions of CO_2 and other compounds emitted into the atmosphere while generating power in a conventional manner. With coal (the main type of fuel used by power plants generating electricity in Poland) serving as a benchmark, it may be stated that the construction of a photovoltaic system with a capacity of approx. 200 kWp will contribute, over a period of 25 years, to reducing emissions by 1,400 t of CO_2 and by nearly 15 t of particulate matter, SO_2 and NO_2. Emissions of such substances as heavy metals, dioxins, aromatic hydrocarbons, including carcinogenic benzopyrene, will be reduced as well. The project will improve air quality in the region, thus exerting a positive impact on human health and the environment. The plans assume that a solar system with the capacity of approx. 200 kWp will be constructed, with more than 90% of the power generated being used on site.
2. **Replacement of a worn vacuum pump** and installation of a newer, higher capacity and more power-efficient one. Renovation of the Vacuum Pump Station and replacement of the old electrical system.
3. **Purchase of a 140 kW power generator** to increase the amount of power supplied to backup circuits for added patient safety and to ensure continuity of hospital operations in emergencies.
4. **Modernization of the anatomy laboratory and replacement of worn-out and energy-intensive equipment used for storing human remains.** Replacement of the cold room for storing human remains with a refrigeration unit relying on an environmentally friendly refrigerant (elimination of freon gas).
5. **Construction of a computer tomography (CT) laboratory** to improve the patients' access to diagnostic tools (the device plays a crucial role in diagnosing cancer, civilization diseases and post-COVID-19 conditions).
6. **Connecting the main hospital building with the newly established Rehabilitation Department** in order to provide access to diagnostic labs and streamline logistical processes involving transporting patients between buildings.
7. **Construction of a rainwater collection** facility streamlining the management of rainwater to ensure self-sufficiency, achieve economic advantages and eliminate the fees for discharging rainwater into the sewage system. A clean and free source of chlorine-free water will be created. It will be used for watering plants in an environmentally friendly manner.

HOSPITAL ENVIRONMENT – QUALITY OF AIR AND WATER, WASTE MANAGEMENT

The hospital is located in the town of Wolica, approx. 150 km south of Poznań. The facility is surrounded by a pine forest which is the source of a unique microclimate (trees, reduced emission levels and dispersed building locations). According to the air quality standards set in the directives of the European Parliament and the EU Council, the average permissible concentration level of particulate matter is 40 μg/m^3 for PM_{10} and 25 μg/m^3 for $PM_{2.5}$.

The Wolica Hospital is located in the district of Godziesze Wielkie, boasting an average annual PM_{10} concentration level of 25-30 μg/m^3 (over an area of 104.0 km^2), $PM_{2.5}$ concentration level of 15-20 μg/m^3 (over an area of 26 km^2) and of 20-25 μg/m^3 (over an area of 78 km^2). All of these values are well within the limits set by the EU.

No large manufacturing plants are located in the municipality and the hospital in Wolica is one of the largest facilities in the vicinity, meaning that the values presented above may be overestimated. The actions the hospital took over the past years to reduce greenhouse gas emissions and decarbonize its heating system have definitely contributed to achieving pollution levels that are well below the values recommended by the EU. It is not without significance that we replaced, in 2003, a coal-fired boiler with one using natural gas and heating oil. The entire heating system has been modernized in a comprehensive manner as well. The investment contributed to reducing emissions of harmful gases and dust into the atmosphere. The annual consumption of coal reached approximately 360 t and contributed to emitting 5.04 t of sulfur oxide, 0.76 t of nitrogen oxide, 18 t of carbon monoxide (CO), 720 t of carbon dioxide (CO_2), 3.6 t of particulate matter, and 5.4 kg of benzo(a)pyrene. In equivalent amounts, the combustion of natural gas produces 30% to 45% less carbon dioxide.

At present, emissions of sulfur dioxide (SO_2) and other compounds are negligible. The replacement of the heat source has therefore contributed to reducing the greenhouse effect. In addition, forest areas used previously for storing fuel have been reclaimed as well, thus reducing soil and groundwater pollution.

Care for the natural environment requires that we pay special attention to the quality of air and soil. The premises of the hospital in Wolica cover more than 20 hectares of forest we are responsible for. We plant new trees, maintain bird nesting locations and habitats for

mammals living in the area. Forests are managed in accordance with the Forest Management Plan. We actively cooperate with the Kalisz Forestry Authority. These activities are crucial for us - the environment is one of our key assets and we go to great lengths while taking good care of it. The unique microclimate of our health resort, created by pine forests, has a beneficial effect, especially on the upper respiratory tract and contributes to the treatment of pulmonary diseases and rehabilitation programs available at the hospital.

We are self-sufficient in terms of access to drinking and process water. In 2014, we drilled a deep well. This project ensures continuity of water supply (with suitable quality parameters maintained) and allows us to reduce the consumption of district water.

In 2019, we upgraded our hydrofracking system and the water disinfecting installation. As part of the thermal modernization project, thermostatic valves were installed and the technical infrastructure, including the electrical system, radiators, as well as door and window frames, was modernized. A solar farm was installed on roof of the technical building to power the hydrofracking system. The investment contributed to increasing the efficiency of the drinking water disinfection and purification installation. Both energy efficiency and quality of water have improved.

All waste at the hospital is segregated in accordance with the established rules. Medical waste generated while providing healthcare services, in which biological pathogens are identified or which may be reasonably suspected to contain such pathogens, is stored in conditions that are suitable for its nature, with the disposal or recovery method taken into consideration as well.

The year 2020, with the pandemic of the SARS-COV-2 virus that causes the COVID-19 disease, posed another challenge for the Wolica hospital. By order of the Wielkopolska Province Governor, we were transformed, on two separate occasions, into a facility treating patients with COVID-19: on the first occasion, we were named a ‘single-profile hospital’, and on the other a ‘level II hospital’. For more than 6 months, we were admitting and treating COVID-19 patients only. The hospital actively joined the fight against and counteracted the effects of the epidemic, operating on the battle’s front line. The emergency proved that the hospital in Wolica is highly flexible and is capable of adapting to new diagnostic and treatment-related challenges while serving the general public. In the middle of the forest, in a beautiful, albeit old building, we treated up to 120 patients at a time, as this is the number of beds available. We introduced special procedures for dealing with infectious waste, amending the contracts signed earlier, in 2020, to adapt them to the actual needs arising from the state of epidemic. Thanks to funding from the Provincial Fund for Environmental Protection and Water Management in Poznań, in 2021 we implemented a project concerned with the disposal of highly infectious waste generated by the hospital while combating COVID-19. A total of 46 transports of medical waste marked with the 18 01 032 code were made under the project. A total of 17.28 Mg of infectious medical waste was confirmed to have been received, including 13.47 Mg of waste generated in connection with countering COVID-19. In view of the fact that medical waste disposal services generate high costs - the subsidy exerted a positive impact on the hospital's finances and allowed us to pursue other projects, including those involving the introduction of pro-environmental measures.

The healthcare sector accounts for 4.4% of global carbon dioxide emissions. This means it pollutes the environment more than shipbuilding or aviation industries. The solutions implemented in previous years at the hospital in Wolica, as well as the projects planned for the future have a real impact on reducing emissions of harmful substances into the environment, allow us to conserve water resources and reduce the amount of waste we generate.
Over the past few years, the hospital has implemented a number of projects with a real environmental impact. We have been recognized internationally and accepted into the GGHH association focusing on sustainable development and protection of natural resources. Investments in infrastructure and technology, particularly those that relate to sustainable development, are of strategic importance for the hospital. The overarching goal is to create a so-called "green hospital" in Wolica, with its activities being environmentally neutral.

Our plans for the next two years:

1.

Compliance with the zero-waste rule. We have already taken the first steps towards this goal by purchasing a composting machine (in was acquired in 2022). It will reduce the amount of waste we generate, and the automated process will produce a pre-compost mixture to fertilize the soil. Each day we throw away 20-30 kg of (uncontaminated) food waste, additionally producing other types of biodegradable waste (created, for instance, while maintaining green areas or having the form of biodegradable packaging). This adds up to more than 9 tons of waste each year (approx. 70 kg per patient, on average). In 2019, a comprehensive study conducted in the framework of the PROM project by Food Banks estimated that 4.8 million tons of food are wasted each year,

with 2.9 million tons being thrown away in households (an average of approx. 79 kg per person). The average result achieved by our hospital is similar. Although hospitals find it difficult to optimize serving sizes (the meals are adapted to patient needs and the menus are consulted with a dietary expert), we consider the amount of waste we produce to be excessive. The composting machine will allow us to process all types of biodegradable waste by relying on accelerated and controlled organic decomposition. In the course of the process, waste will be transformed into compost that is not classified as waste and is intended for use in biologically active areas to improve soil fertility. Such an approach will truly optimize our waste management practices and will allow us to manage waste in an environmentally friendly manner. Additionally, by implementing, at our hospital, new rules for handling biodegradable waste, we will promote environmental education and will improve public awareness of sustainability-related issues. The waste composting process will be fully activated in 2023.

2.
We plan to install heat pumps to power the hospital building and the administration building.

3.
We plan to install water softening stations at the water treatment plant. Aerators will be installed on all taps throughout the building as well.

4.
Continuation of investments to increase the number of beds – a superstructure relying on modular technology.

5.
Replacement of the vehicle fleet with electric-powered ambulances, installation of electric vehicle charging stations.

6.
Construction of parking lots, resurfacing the access road and the driveway, upgrading outdoor lighting systems.

The hospital is also considering the use of green hydrogen to potentially replace, in the future, natural gas used to heat hospital buildings. The technical feasibility of switching to hydrogen-based heating while keeping the existing gas infrastructure and adapting it to transporting and distributing hydrogen - both as an admixture to the “classic” natural gas fuel and as pure hydrogen - is currently being studied.

The overarching goal is to create a green, environmentally neutral hospital in Wolica. The investment projects we have completed, as well as those we plan in the future, all have a real impact on reducing emissions of harmful substances into the environment, preserving water resources and decreasing the amount of waste generated.

Innovation and eHealth Center Carol Davila University of Medicine and Pharmacy, Bucharest, Romania

THE NEED OF INTEGRATING TELEMEDICINE FOR SUSTAINABLE HEALTHCARE DELIVERY IN RURAL AREAS OF ROMANIA

The history of telemedicine in Romania began in 2001 when the Romanian Space Agency (ROSA) launched the country's first pilot project [1]. Since then, several projects aimed at developing telemedicine within the medical system have been initiated, but many have not been successfully continued for various reasons. One noteworthy project was establishing a telemedicine network in the Danube Delta, which was launched in 2012 at the government level but later abandoned due to connectivity issues and the absence of a legal framework [2].

In the private sector, various online solutions emerged in 2016 and steadily gained traction. However, in 2018, a report by the European Commission ranked Romania last in per capita income generated from eHealth activities [3]. This result was likely due to inadequate investments in healthcare digitization and the low demand for telemedicine services among Romanian patients.

The Covid-19 pandemic played a significant role in exponentially increasing the utilization of telemedicine services in the Romanian market. In response, the Romanian government introduced Emergency Ordinance 196/2020, which amended Health Law No. 95/2006 and included regulations defining and accepting teleconsultation, teleexpertise, teleassistance, teleradiology, telepathology, and telemonitoring services [4]. Subsequently, in September 2022, the Ministry of Health approved and published the implementation rules for telemedicine services outlined in Emergency Ordinance 196/2020. These rules govern the conditions for utilizing telemedicine services [5]. However, telemedicine services are reimbursed in the public sector for a limited number of conditions (chronic conditions, contagious diseases, genetic advice, psychiatry, and psychology) and a limited number of teleconsultations (one per person per month for chronic conditions, two per person per episode of contagious diseases). Consequently, the volume of reimbursed telemedicine services provided by the public sector decreased. [6]

As a result of the lockdown measures in 2020 and the legalization of telemedicine services, many private healthcare providers launched specific teleconsultation and telemonitoring services.

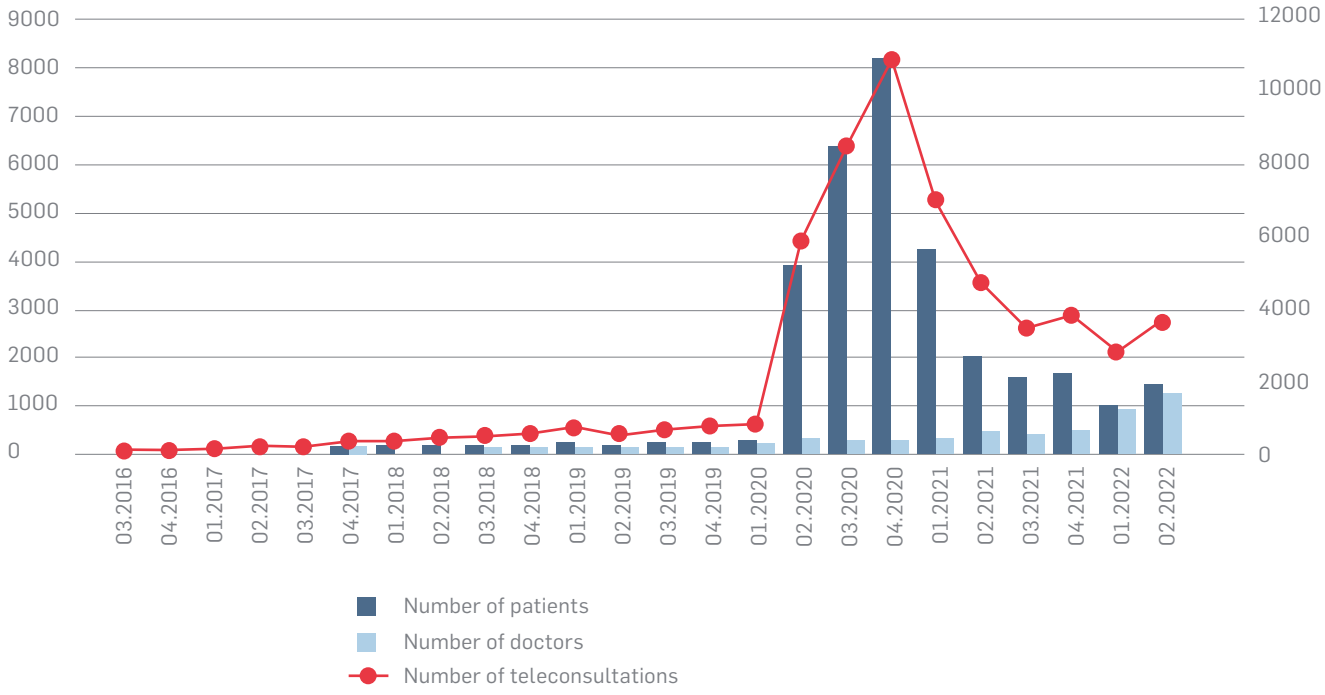
In terms of healthcare professionals' perception of telemedicine, a study conducted between April and September 2020 evaluated the opinions of 108 family doctors from Cluj County. The results indicated that two-thirds of the doctors found teleconsultation to be more challenging and time-consuming, potentially impacting the accuracy of diagnoses. Nevertheless, over 90% of the participants believed telemedicine should be retained and reimbursed alongside in-person consultations [6].

Another study, conducted by the Center for Innovation and eHealth at the Carol Davila University of Medicine and Pharmacy in Bucharest, surveyed healthcare professionals from various specialties nationwide. Most respondents viewed telemedicine as an integral part of the healthcare system, capable of addressing existing challenges. Most healthcare providers expressed a willingness to utilize telemedicine services extensively, with many showing openness to further education on this innovative technology. Telemedicine was perceived as trustworthy, secure, user-friendly, cost-effective, and successfully implemented during the COVID-19 pandemic. However, concerns were raised regarding the current legislation, and less than half of the respondents reported using dedicated secure software.

A third study, conducted by the MedicHub platform in partnership with Atlas, collected 1,417 responses from physicians nationwide. Approximately 64.50% of the respondents confirmed using telemedicine, predominantly through insecure digital channels. The majority desired to utilize telemedicine services and emphasized the importance of adequate training to navigate these platforms effectively.

According to the Competition Report in Key Sectors issued by the Competition Council in November 2022, although the number of telemedicine services decreased in the post-pandemic period, the trend is above the pre-pandemic levels, patients are using telemedicine services repeatedly, and the number of doctors providing telemedicine services is rising to show their interests for these services.

Figure 1.
Telemedicine evolution



Source: Completion Council, 2022, Inquiry of telemedicine platforms

According to the Competition Report in Key Sectors issued by the Competition Council in November 2022, although the number of telemedicine services decreased in the post-pandemic period, the trend is above the pre-pandemic levels, patients are using telemedicine services repeatedly, and the number of doctors providing telemedicine services is rising to show their interests for these services.

HEALTHCARE CHALLENGES IN RURAL AREAS OF ROMANIA

In rural areas of Romania, one of the major healthcare challenges is the limited access to healthcare facilities and specialists. Due to the geographical spread and lower population density, rural regions often face a shortage of healthcare infrastructure. The concentration of medical facilities and specialists tends to be higher in urban areas, making it difficult for rural residents to access timely and appropriate healthcare services. While half of the Romanian population lives in rural areas [7] and population ageing is impacting the health sector due to chronic conditions requiring long-term treatment, the precarious prevention throughout Romania leads to over-utilization of hospital services [6].

The scarcity of healthcare facilities in rural areas means that residents must travel longer distances to reach the nearest hospitals or clinics. This can be particularly challenging for individuals with limited mobility, the elderly, or those living in remote areas with poor transportation networks. The lack of accessible healthcare facilities often results in delayed medical care, leading to potentially worsened health conditions and poorer health outcomes for rural populations.

Moreover, the availability of specialists is significantly limited in rural areas. Residents may need to travel to urban centres to consult with specialized physicians,

leading to additional costs and inconveniences. The scarcity of specialists in rural areas can result in delayed diagnosis, inadequate treatment, and a lack of follow-up care, exacerbating health disparities between rural and urban populations.

The scarcity of medical infrastructure poses challenges for various healthcare interventions, including diagnostic tests, medical imaging, and specialized treatments. Limited access to modern medical technologies in rural areas can lead to diagnostic delays, reduced accuracy in medical assessments, and suboptimal patient management.

High costs and the travel burden for patients are significant challenges faced by rural residents seeking healthcare services. Travelling long distances to reach healthcare facilities in urban centers consumes valuable time and imposes financial strains on individuals and families, especially those with limited financial resources.

The costs associated with transportation, including fuel expenses, public transportation fares, or taxi fees, can be substantial for rural residents who need to visit healthcare facilities frequently. Additionally, the need for overnight accommodations in urban areas, particularly for patients undergoing long-term treatments or surgeries, adds to the financial burden.

Addressing these challenges requires targeted efforts and investment in improving healthcare infrastructure, increasing the availability of healthcare professionals, and implementing innovative solutions such as telemedicine to bridge the gap between rural and urban healthcare services. By prioritizing equitable access to healthcare and allocating resources appropriately, Romania can work towards reducing health disparities and ensuring that all residents, regardless of their geographical location, have access to quality healthcare services.

Telemedicine has emerged as a powerful tool in improving healthcare delivery, particularly in rural areas. It offers numerous advantages that address the unique challenges faced by rural populations, such as limited access to healthcare services, high healthcare costs, and difficulties in receiving timely interventions.

Firstly, telemedicine significantly improves access to healthcare services for rural populations. Rural areas often lack sufficient healthcare facilities and specialists, making it challenging for individuals to receive timely and appropriate medical care. With telemedicine, patients can remotely connect with healthcare providers through video consultations, phone calls, or secure messaging platforms. This eliminates the need for long-distance travel and allows individuals to access healthcare services from the comfort of their homes. Telemedicine also enables rural healthcare providers to collaborate with specialists in urban centres, facilitating access to expert opinions and specialized care that may not be available locally.

Secondly, telemedicine reduces healthcare costs for both patients and healthcare providers. Rural populations often face financial barriers in accessing healthcare due to transportation costs, time off work, and the need to travel long distances for appointments. Telemedicine eliminates these expenses by enabling virtual consultations, which saves travel costs and reduces the need for hospitalizations or emergency room visits. Telemedicine can lead to cost savings for healthcare providers by reducing the burden of maintaining extensive infrastructure and personnel in rural areas, making healthcare services more economically viable.

Lastly, telemedicine enhances patient outcomes through remote monitoring and timely interventions. Rural communities often face challenges managing chronic conditions and accessing timely medical interventions. Telemedicine provides remote monitoring capabilities, allowing healthcare providers to monitor patients' vital signs, medication adherence, and overall health status from a distance. This enables early identification of potential complications and the ability to intervene promptly. For example, telemedicine can enable timely adjustments to medication dosages, dietary recommendations, or exercise plans for patients with chronic diseases, thereby improving their overall health outcomes.

In conclusion, telemedicine brings significant advantages to rural healthcare. It improves access to healthcare services, reduces healthcare costs, and enhances patient outcomes through remote monitoring and timely interventions. By leveraging technology, telemedicine has the potential to bridge the healthcare gap between urban and rural areas, ensuring that individuals in rural communities receive the healthcare they need, regardless of their geographical location.

Telemedicine has the potential to revolutionize healthcare delivery in rural areas, but several challenges and considerations must be addressed to ensure its successful implementation.

The first challenge is internet connectivity and the digital divide in rural areas. Rural communities often face limited or unreliable internet access, hindering the seam-

less delivery of telemedicine services. The lack of broadband infrastructure and high-speed internet connections can impede video consultations, data transmission, and remote monitoring. To overcome this challenge, efforts must be made to improve internet infrastructure in rural areas, including expanding broadband networks and implementing telecommunication policies that prioritize rural connectivity. Additionally, alternative solutions like mobile networks and satellite-based internet services can be explored to ensure adequate internet access for telemedicine in rural areas.

The second challenge is telemedicine's legal and regulatory framework in rural areas, specifically in Romania. Telemedicine involves using technology to provide healthcare services, and its regulatory landscape varies from country to country. In Romania, it is crucial to establish clear guidelines and standards for telemedicine practice, including licensure requirements, data privacy and security regulations, and reimbursement policies. A comprehensive legal framework should address healthcare provider-patient relationships, prescription regulations, and liability concerns. Engaging stakeholders, including healthcare professionals, legal experts, policymakers, and patient advocacy groups, is essential to develop an effective and robust regulatory framework for telemedicine in rural areas.

The third challenge is healthcare professionals and patients' acceptance and adoption of telemedicine. Telemedicine represents a significant shift in healthcare delivery, requiring healthcare professionals to adapt to new technologies and workflows. Education and training programs should be implemented to familiarize healthcare professionals with telemedicine tools, ensuring they are comfortable and competent in providing remote healthcare services. Additionally, engaging healthcare professionals in the development of telemedicine policies and guidelines can foster their acceptance and ownership of telemedicine initiatives.

Moreover, patient acceptance and adoption of telemedicine are crucial for its success. Educating patients about the benefits and functionalities of telemedicine, addressing concerns regarding privacy and confidentiality, and ensuring user-friendly interfaces and platforms are important considerations. Collaborating with community leaders, patient advocacy groups, and local healthcare providers can help promote the benefits of telemedicine and increase patient confidence in its use.

In conclusion, while telemedicine holds immense potential for improving healthcare delivery in rural areas, challenges specific to these regions must be carefully addressed. Key considerations include Internet connectivity, the legal and regulatory framework, and acceptance by healthcare professionals and patients. By focusing on these challenges and implementing appropriate solutions, telemedicine can effectively bridge the healthcare gap in rural areas, ensuring equitable access to quality healthcare services for all individuals, regardless of their geographical location.

Octavian Andronic

Gabriela Paleru

Ștefan Busnatu

Ana Maria Alexandra Stănescu

Diana Loreta Păun

Viorel Jinga

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Instytut Matki i Dziecka

The Institute of Mother and Child in Warsaw

The Idea of Green Hospitals at the Institute of Mother and Child – innovation, sustainable development and social responsibility of hospitals

The idea of Green Hospitals addresses current environmental challenges and satisfies the basic needs of society. Although human health is indirectly determined by a number of features of the surrounding infrastructure, we fail to focus on this specific issue as frequently as we should be doing. This is particularly important in the hospital environment, as numerous studies show a clear correlation between the materials used in hospitals and the longer patient recovery times as well as the higher number of sick days taken by staff members. Climate change and unsustainable use of resources are contributing to the deterioration of the health of societies around the world. The healthcare sector caters to the needs of local communities, thus meeting social responsibility-related goals, ensuring sustainability and protecting the environment.

The Mother and Child Institute is a specialized center that has been conducting clinical, research and scientific activities since 1951. The institution offers a comprehensive range of services while caring for women and children during pregnancy and after birth, also if the patients are diagnosed with serious diseases. The range of health problems that the Mother and Child Institute participates in solving depends on the current social needs and the state's health policy. The key areas of our activity include the following: cancer in children and youths; premature birth, low birth weight and other developmental disorders, perinatal infections, diseases resulting from adverse environmental conditions and lifestyles, as well as psychosocial development disorders encountered in early childhood and during adolescence. Each year, the Institute assists approximately 100,000 patients from Poland and around the world. "We keep fighting, each day, for the health, dignity and joy of our patients, keeping in mind the greatest value of all - human life."

The Mother and Child Institute is constantly evolving. Despite the Covid-19 pandemic, the facility has not halted the planned patient admissions or its infrastructural upgrade projects. Within the framework of the POIS/1.3.1/1/2015 award procedure, a contract was signed on 21 June 2017 for subsidizing the project titled "Improvement of energy efficiency of the building of the Mother and Child Institute in Warsaw with the use of RES technologies". The task included the removal and disposal of exterior wall cladding and finishing materials containing asbestos. The central heating system was modernized (cast-iron radiators without any temperature control systems were replaced), the hot water system was upgraded (hot water storage tanks were installed) and the heat sources were replaced with gas-fired heat pumps. A mechanical ventilation and air conditioning system was installed in the building as well. Insulation of exterior walls with 18 cm thick styrofoam was also carried out, reducing their thermal conductivity coefficient to λ = 0,04 W/(m*K). The roof of the building was insulated with special 25 cm mineral wool offering a thermal conductivity coefficient of λ = 0,04 W/(m*K). Aluminum windows were replaced with PVC counterparts characterized by the heat transfer coefficient of U = 0,9W/(m^2*K).

The building's lighting system was modernized by installing energy-efficient LED fixtures.

DESCRIPTION OF ACTIVITIES UNDERTAKEN UNDER THE PROJECT

Improving energy efficiency by applying RES technologies in the building of the Mother and Child Institute in Warsaw

Modernization of heat sources under the project in question:

1. The following have been installed:
   - 4 gas heat pumps (GHP) with a total capacity of 240 kW (60 kW each), operating in an air-to-air configuration and cooperating with HYDROBOX intermediate modules
   - Solar thermal collectors with a capacity of 90 kW, to supply hot water.
2. Waste heat generated when cooling gas heat pump (GHP) motors is used to supply hot water. 2 x 750 l hot water storage tanks.
3. Installation of PV panels with a total capacity of 35 kW.
4. The indoor spaces of the building are ventilated mechanically, with a heat recovery system installed.

The total capacity of the newly installed systems equals 425 kW.

Metering systems

A new metering system with additional heat meters has been installed to measure the amount of heat used by the building's specific installations (central heating, process heat, hot water). The amount of heat generated by gas heat pumps (GHP) and solar thermal collectors, used in central heating, process heat and hot water systems, is measured by additional heat meters.

Photovoltaic system

In keeping with the environmental initiatives of the government of the Republic of Poland, the Mother and Child Institute installed, on 9 August 2018, a photovoltaic system on the roof of its "A" building. The source of "clean" electricity has the capacity 35 kW.

The panels and the two inverters are made by Goodwe.

Electricity generated by this system is fed into the RPG-12 switching station and powers the Institute's grid. The operating status of both photovoltaic inverters may be controlled via the BMS monitoring system. The solution shows the current operating state of the system and records the amount of electricity produced by the panels, as this varies depending on prevailing weather conditions, and especially on the amount of sunlight.

A second photovoltaic system with a capacity of 45 kW is currently being installed on the roof of the "B" building to reduce the amount of electricity consumed from the national grid.

BMS (Building Management System). On 20 July 2018, a BMS solution was launched at the Mother and Child Institute. The system is based on the Desigo v6.1 solution by Siemens. 2 operator stations of the BMS system were installed: one in the control room of B Building, and the other at the office of the Head of the Infrastructure Management Department in A Building. The BMS is a user-friendly tool assisting the staff of the Infrastructure Management Department in properly maintaining the Institute's technical infrastructure. The officer on duty may set the temperature and the amount of air supplied to each of the Institute's clinics, operating theaters and laboratories, in real time. He is also informed about any equipment malfunctions or critical infrastructure failures.

The implementation of the BMS aimed to meet the applicable technical and functional requirements and was intended to ensure full stability, as well as safe and secure operation of all equipment and sanitary installations (heat meters / water meters / air handling units / heat exchange nodes / GPC / solar thermal collectors), electrical systems (switching stations / photovoltaic systems / UPS), installed and operating in the Lipsk (A) building.

Currently, the BMS is being expanded and new devices are being installed in "B" and "C" buildings.

Fourteen nesting boxes for birds have been installed on A Building.

Social facilities and garage building - thermal modernization

The Social Facilities and Garage Building has undergone thermal modernization to effectively reduce its energy consumption.

The project covered the following:

- Insulation of external walls, above the base of the building, with 14 cm thick styrofoam offering the thermal conductivity coefficient of 0.031 W/(m*K)
- Insulation of external foundation walls and the base of the building with 10 cm thick XPS styrofoam offering the thermal conductivity coefficient of 0.035 W/(m*K), application of a damp proofing layer
- Insulation of external walls above the ground, on the inside of the building, with 10 cm thick resol panels offering the thermal conductivity coefficient of 0.020 W/(m*K), facade
- Insulation of the roof with 12 cm thick mineral wool offering the thermal conductivity coefficient of 0.040 W/(m*K) - uninsulated part
- Insulation of the floor with 10 cm thick XPS styrofoam offering the thermal conductivity coefficient of 0.035 W/(m*K) - excluding technical rooms
- Replacement of exterior doors made of wood (some of the door openings have been bricked up) with new door leaves offering the thermal conductivity coefficient of U = 1.3 W/(m*K)
- Modernization of the gravity ventilation system: installation of adjustable wall-mounted diffusers (32 units) and installation of hybrid chimney cowls (13 units) to facilitate the extraction of gases in conditions in which no chimney draught is present
- Insulation of external (above ground) and foundation walls with 14 cm thick styrofoam (W facade, above the base of the building) offering the thermal conductivity coefficient of λ= 0.031 W/(m*K). The seamless method has been applied and the walls have been finished with a layer of plaster. In order to eliminate thermal bridges, the foundation walls and the base of the building have been insulated with 10 cm thick XPS styrofoam offering the thermal conductivity coefficient of λ= 0.035 W/(m*K).
- Insulation of the roof in the previously uninsulated part of the building. The old roofing was removed and the ceiling was insulated with the use of 12 cm thick mineral wool offering the thermal conductivity coefficient of λ= 0.040 W/(m*K). Then, new roofing covering was installed.
- Insulation of the ground floor - with the exception of technical rooms. The existing floors were removed, the floor on the ground level (with the exception of technical rooms) was insulated with a 10 cm thick layer of XPS styrofoam offering the thermal conductivity coefficient of λ = 0.035 W/(m*K), and a new floor has been installed. Additionally, garage floors have been thermally insulated as well.
- Exterior doors made of planks have been replaced with thew doors offering the thermal conductivity coefficient of U = 1.3 W/(m*K). The surface area of one door was reduced by bricking a part of the opening up with the use of 24 cm thick Ytong blocks offering the thermal conductivity coefficient of λ = 0.11 W/(m*K) and applying a 14 cm layer of styrofoam (with the same properties as the material used on other external walls).
- Modernization of the gravitational ventilation system, including the installation of adjustable wall-mounted diffusers (32 units) and the installation of hybrid chimney cowls to facilitate the extraction of gases in conditions in which no chimney draught is present (13 units).
- As part of the comprehensive modernization of the building, a mechanical ventilation system (supplying and extracting air) has been installed in the sanitary facilities of the garages.
- Replacement of central heating system.

BUILDING B (Clinical Building) - some work is still in progress

Thermal modernization project - insulation of external walls with 5 cm thick insulating plaster that contains expanded perlite (λ=0,064 W/m*K).

Vapor-permeable coatings were used as the external and decoration layer. An intermediate layer made of adhesive with an embedded netting was used. The wooden structure of the roof has been replaced, along with the roofing itself. The technical and the usable attic has been insulated with mineral wool. Additionally, the old window frames have been replaced with the following:

1. single-frame windows,
2. thermal conductivity coefficient: U ≤ 0.9 W/(m*K),
3. material: PVC - 7-chamber frames with the installation width of 80-82.5 mm,
4. glazing: clear, safe, stopsol-type with low-emissions coating, 3-pane inserts, 52-53 mm thick.

The upgrades to the interior of the clinical building completed over the recent years have reduced gas emissions thanks to:

1. installation of natural gas-fired heat pumps;
2. replacement of the pumping system;
3. installation, in the renovated areas, of new radiators with thermostatic valves;
4. modernization of the heat exchanger station;
5. installation of solar thermal collectors supplying hot water;
6. use of a fully controlled, mechanical ventilation system (supply and exhaust air)
7. with a heat recovery solution;

Modernization of heat sources installed at the Mother and Child Institute:

1. Installation of the following:
   - 8 gas heat pumps (GHP) with a central heating and process heat power rating of 398 kW, ice water power rating of 156 kW and hot water power rating of 85 kW (operating in an air-to-air configuration and cooperating with HYDROBOX intermediate modules)
   - solar thermal collectors with a capacity of 97 kW, to supply hot water.

2. Waste heat generated when cooling gas heat pump (GHP) motors is used to supply hot water (its power rating equals 90 kW). 2 x 1500 l hot water storage tanks.

3. The indoor spaces of the building (in the cellar and on the ground floor) are ventilated mechanically, with a heat recovery system installed.

Central heating disinfection system

In December 2019, the Institute procured and installed a system to maintain the hot water installation in a condition that complies with the requirements set out in the Regulation of the Minister of Health of 7 December 2017 on the quality of water intended for human consumption with regard to the control of Legionella sp. bacteria.

The Bifipro system relies on the electrolysis method to inject silver and copper ions into the water. Silver ions work as a disinfectant. They kill bacteria and prevent them from reproducing. Copper ions destroy the biofilm present in the system. The biofilm is a natural habitat for Legionella bacteria.

By removing the biofilm from the system, the bacteria are deprived of suitable conditions for growth. Thanks to the Bifipro technology, we have eliminated the Legionella bacteria in an environmentally friendly manner (without chlorinating the water). This approach has allowed us to avoid superheating the water and, thus, to extend its useful life.

Wastewater disinfection system installed in B Building - the Institute has been operating, since December 2020, the DZ-03 wastewater disinfecting device which relies on sodium hypochlorite for pre-treating wastewater and thus allows to avoid dumping wastewater with pathogenic microorganisms into the sewage facilities.

Other environmentally friendly solutions:

1. The institute employs its own technical staff (maintenance workers) which significantly increases the share of equipment that may be repaired instead of being replaced.

2. Installation of drinking water dispensers in the Institute's corridors effectively reduces the number of plastic bottles used.

3. Modern waste segregation bins have been placed on the Institute's premises. With clear markings, they also make segregation easier for younger patients.

4. Electricity consumption is reduced by maintaining machinery and equipment in a good working condition (this applied also to the ventilation system). The Institute performs regular inspections technical and medical equipment, in accordance with manufacturers' recommendations. A great emphasis is placed on the good technical condition of the ventilation and air conditioning system. In addition to regular inspections of the ventilation system, the Institute performs, once every 5 years, an in-depth assessment of the efficiency and functionality of air-conditioning devices with a cooling capacity of more than 12 kW.

5. It should be emphasized that the Institute's maintenance staff keeps the use of internal combustion equipment to a minimum. Combustion engine-powered leaf or snow blowers are not used. The premises are maintained with the use of zero-emission tools.

6. The electronic document circulation system is being introduced in a proactive manner. It has significantly contributed to reducing the amount of paper used in the Institute's internal processes and has provided our staff with more freedom when it comes to working remotely.

The new building - environmentally friendly and technologically advanced solutions

The Mother and Child Institute is planning to expand and modernize its "B" (Clinical) building. The purpose of the project titled "Establishment of an interdisciplinary treatment and diagnostic center at the Mother and Child Institute" is to improve access to high-quality specialized healthcare, in particular in the field of maternal and fetal medicine, perinatology and neonatology, facial surgery, spinal surgery and orthopedics, oncology, pediatrics and treatment of rare diseases.

The aim of the project is to boost the potential of the Mother and Child Institute by erecting a modern clinical and laboratory building connected, by means of connecting corridors, with the modernized B Building (the current clinical building).

1. The project assumes that a new building (D) will be erected and that the existing B Building will be modernized by insulating its walls, roof and foundations to significantly facilitate the process of maintaining proper temperature and humidity levels throughout the facility. The new D building and its connection with the existing B building will be designed taking into account the appropriate level of thermal insulation of the walls and the roof, as such an approach will reduce operating costs and will mitigate the amount of heat emitted into the environment. A properly installed insulation layer will effectively eliminate any thermal bridges, preventing unnecessary release of heat into the environment.

2. The buildings will be equipped with windows offering the best thermal insulation properties. Such windows are capable of significantly reducing the loss of heat in wintertime.

3. The buildings will have their exterior and interior doors installed/replaced with models characterized by low heat conductivity coefficients. Suitable door frames are a very important element of a building's structure, as they are crucial from the point of view of heat losses. The replacement of doors and installation of models with good heat conductivity coefficients has a major impact on the thermal performance of the entire building, as draughts and thermal bridges may be present at the locations at which they are installed. Properly selected exterior doors can reduce heat losses generated at those locations, thus decreasing the amount of energy required for heating the building.

Design of new D building

4. The central heating, hot water and ventilation systems will be replaced in the B Building (the one that is in use currently). Currently, gravity ventilation systems continue to be use in some Clinics and at the Screening Testing Department. They rely on the difference in temperature inside and outside the building, but are not capable of controlling the amount of air exchanged which depends on the prevailing weather conditions. Ventilation systems of this particular type are inefficient and fail to meet the applicable epidemiological requirements. Mechanical ventilation systems with heat recovery solutions will be installed in both buildings, offering full control over the amount of air exchanged. Properly installed, such systems are capable of reducing the building's heat demand by up to 25%.

5. Solar panels will be installed on the new building to significantly improve its energy efficiency. The right choice of PV panels is crucial. New high-efficiency solar panels, such as those of the SUN-LONGI-HC120 380W Long type, rely on the technology of 120 split cells to prevent the loss of current and ensure maximum performance, even when the module is partially shaded.

6. Modern bathroom fixtures will be installed throughout the Institute. High efficiency tap aerators will be used as well to reduce water consumption.

7. A smart energy management system will be installed within the framework of the project as well. Energy-efficient lighting with an intelligent management system will be installed in the buildings and outside the building. Optimized lighting management algorithms (with automatic power control and use of daylight) guarantee significant savings compared with common technologies.

The smart solution used allows to collect data and harness it for optimization purposes.

8.

The investment will include the installation of a thermal energy management system, which will reduce energy consumption. Solutions using Big Data analytics and auto-analytical systems make it possible to optimize the thermal load of buildings and district heating networks. By learning a building's energy consumption patterns, smart solutions for buildings and district heating networks make it possible to reduce overall energy consumption. The installation of the system allows to manage the current energy-related systems in a more effective manner and to face the challenge of increasing energy demand in the years to come. By using real-time data collected from different areas in the building (indoor temperature and humidity levels, current energy consumption), the system analyzes the patterns and is capable of reducing energy consumption by at least 10%. The system allows to optimize energy consumption by adjusting the supply of heat to the varying loads experienced in the buildings, while simultaneously maintaining the comfort of users. Reduced energy consumption will contribute to mitigating adverse environmental impacts.

9.

The scope of work performed in B Building includes also replacement of the central heating system. This will allow to reduce costs and the amount of heat emitted into the environment. The investment will bring about a reduction in the quantities of harmful substances (carbon dioxide) emitted into the environment. The reduction will stem from lowering the energy demand of the modernized building.

10.

A BMS (Building Management System) will be installed as part of the project, allowing to monitor and manage all systems and pieces of equipment operating in and around the building. Used to manage lighting, heating, air-conditioning or alarm systems, the BMS makes the operation of the building more convenient and efficient. The BMS makes it easier to locate defects, speeds up the process of diagnosing and repairing faults, thus improving the level of safety throughout the hospital. Thanks to the system's remote monitoring functionalities and the ability to trigger alerts in the BMS control room, maintenance and service teams are not required to physically verify the correct operation of each important component. Continued surveillance of operating states and failures taking place at specific locations, as well as intelligent management of ventilation, lighting and water supply systems will contribute to reducing costs, simultaneously make a real difference for the environment.

11.

The purchase of water dispensers used at specific wards - reducing overall consumption of bottled water, reducing the amount of plastic waste. Installation of drinking water filtration stations is another solution that fits in with the sustainable and environmentally friendly approach to management processes that should be typical of all modern buildings. The installation of water filtration stations on each floor of the building will reduce the use of bottled water and will improve the comfort of patients and caregivers by providing them with easy and free-of-charge access to water. Such solutions promote the use of water dispensers among those visiting the Mother and Child Institute, positively translating into health-promoting education.

12.

The project is based on the tenets of the Healing Environment program under which therapeutic spaces are created that improve working and treatment conditions, thus accelerating recovery. This program promotes also increased access to daylight in hospital spaces and contact with nature - both outdoors and at a courtyard located on the roof above the entrance hall. The roof over the ground floor, located between the existing and proposed building, is intended for constructing a green square with trees and a playground. The space will be easily accessible from the Wards located in the existing building and from the new facility, making up for the elimination of the existing playground.

Investing in improving the telecommunications/ process infrastructure

The ever-increasing number of patients and their growing demand for medical services need to be adequately taken into consideration in the medical facility's management plans providing for effective and coordinated use of resources (with human resources included as well). Current technological advances make it possible to monitor and intelligently plan workflows, inter alia by monitoring the load of medical equipment, creating plans to automate repeated activities, and introducing tools to support the medical staff. The implementation of such solutions benefits the patients as well, as they can expect shortened waiting times for tests, a faster diagnosis and a better contact with specialists.

By completing the investment project, the Mother and Child Institute aims to introduce as many MedTech projects as possible, and thus to take advantage of technological advances that may be implemented to support medical personnel, save lives, as well as prevent and treat a variety of diseases. All these products have one goal in

common - they are intended to improve the level of treatment and diagnostics, with the ultimate aim of raising the level of patient care provided.

Thanks to the implementation of the project, it will be possible to improve the telecommunications infrastructure by:

1. Providing wider access to computer networks and stations, thus facilitating interdisciplinary teams' access to electronic medical records. Such an approach will enable the patient's parameters to be monitored in a more efficient manner and will facilitate communication between different Clinics. The investment project will also allow electronic medical records to be processed on mobile devices, thus providing doctors making rounds with immediate access to the patients' test results and medical records.

2. Introduction of an app relying on AI to book appointments over the phone. The solution will improve the efficiency of the telecommunications infrastructure. Patients using the app will be interviewed by AI after establishing the connection (with the conversation focusing on a specific topic) and will then be put through to the appropriate call center operator, or AI will make the appointment for patient itself. The appointment for the appropriate medical service will be made quickly (with the wait for the connection eliminated).

3. Implementation a mobile app for patients, enabling them to follow the so-called "patient path" within the CliniNet system (used in the emergency room and at the registration desk) to collect data in the outpatient clinic, or during the pre-registration (or pre-visit) interview. The solution will improve the effectiveness of the telecommunications infrastructure and will streamline the process of referring patients to specific locations. The introduction of the app linked with the CN system will reduce the workload of medical registrars, thus facilitating the automation of the registration process. It will also reduce the workload of doctors and nurses - the information collected during the interview will be attached to the medical records. Installation of a sip trunk PBX will improve the effectiveness of the telecommunications infrastructure and will enable patients to exercise their rights thanks to faster, easier and better communication with patients, especially via the Call Center. The number of calls that may be answered simultaneously will be increased, which will improve the telecommunications infrastructure.

4. The Institute plans also to implement a special project in cooperation with Microsoft. AR goggles will be used (during the triage procedure in the Emergency Room and then, at a later stage, during rounds at individual wards). They will be integrated with the CN system and with a speech-to-text conversion app to significantly improve the efficiency of the telecommunications infrastructure.

5. Through the purchase of VR goggles that will be used at the chemotherapy ward and in the rooms in which test material (e.g., blood) is collected, patients will be taken to virtual worlds tailored to their age and cognitive skills. This solution will reduce the level of stress and discomfort generated by the administration of chemotherapy or multiple injections. Thanks to its peculiar nature, this solution will also improve the working conditions of the medical personnel fulfilling their daily duties.

6. The implementation of systems used to monitor the workloads of Clinics, as well as to oversee patient tests, medication stocks, patient locations (analysis and forecasting based on pre-defined variables) and to take inventory of the equipment used will help accurately analyze the Institute's operations and thus manage them in a more effective manner. Introduction of the system will make it possible to monitor, in real time, the location of the workload of medical equipment, hospital beds and protective clothing used by medical staff. The use of sensors and an integrated network allows to continuously monitor the use of medical resources, and the results of applicable analyses performed make it much easier to plan and perform diagnostic or therapeutic processes, without the need for involving the personnel physically/by phone. In the long run, such tools make it possible to draw conclusions about the processes/procedures implemented. They also allow to identify problems and eliminate them in an efficient manner thanks to evaluations performed by artificial intelligence algorithms.

7. The plans assume that more equipment will be connected to the CliniNet system (including new ultrasound, CTG and ECG devices, audiometers, EEG, cardiac monitors, neonatal intensive care stations). The equipment used by the Child and Mother Institute currently does not offer any integration capabilities. The purchase of new specialized equipment will make such a connection possible. This is an integral part of a wider plan and plays an essential role in ensuring that a comprehensive range of medical services may be rendered and that the provisions of the regulation

on electronic document management are complied with. Such a solution also allows personnel members logged in to the CliniNet system to check the patients' results from any location within the Institute. The investment will improve the process of communicating with patients via the AI platform, simultaneously optimizing the use of administrative and medical personnel's time.

8. Integration of the surveillance system installed in the operating theater will provide real-time access to video feed from surgical procedures, thus shortening the lead time of specialist consultations and eliminating the need of additional personnel members entering the operating room. Such a solution will have a positive impact on improving the telecommunications infrastructure.

9. Briefing rooms, student lounges and lecture halls will be equipped with video conferencing equipment. All those rooms will be integrated to create a single system, thus facilitating the sharing of information internally and streamlining the process of implementing new technologies used in the educational activities of the medical and scientific community.

10. The purchase of a patient monitoring system with software capable of creating EDM files recording anesthesia parameters in the operating theater and the recovery room will enable the data (i.e. vital signs, dosage of drugs, blood products, infusion fluids) from anesthesia equipment, ventilators, cardiac monitors or infusion pumps to be read automatically. The automatically read measurement values will be stored in the patient's EDM.

11. In cooperation with the Cancer Center, The Institute's Department of Pathomorphology will develop a tool to automatically analyze pathomorphology images in selected cancer cases, using AI-based algorithms. Successful completion of the process of teaching the algorithms will allow to increase the potential (quantities) of evaluating clinical material and will drastically reduce the time spent on these activities. This would be a tool that would significantly streamline the process of taking medical decisions.

12. The development of bit-IT tools and the procurement of data enabling the implementation of analytical approaches relying on artificial intelligence (AI) systems and machine learning (ML) techniques is an indispensable part of the development of the new methodology enabling a more efficient analysis of diagnostic and scientific data.

The investment will allow to integrate the IT systems in use at the Mother and Child Institute. The existing IT systems will be expanded as well to increase the efficiency of the data analysis process, also by integrating data obtained with the use of various omics analytical methods. Integration and expansion of existing databases containing results of genomic analyses (next-generation sequencing, comparative genomic hybridization technique for micro-arrays), used as a point of reference in diagnostic and scientific studies (determination of the prevalence of specific variations in the Polish population, introduction of the possibility of annotating variants of uncertain pathogenicity by the system's user).

The databases of variants/omics/imaging data that will remain at the disposal of the Institute will also be used for implementing methods relying on artificial intelligence (AI) and "self-learning" tools. By expanding its telecommunications infrastructure, the Institute will be more

likely to establish national/international cooperation in the field of sharing databases (owned currently and in the future) in order to facilitate the introduction of big data-based research methods in order to accelerate the application of machine learning solutions; assessment of the available collaboration platforms for their suitability for such cooperation.

The investment project meets the objectives of the DIGITAL EUROPE program aiming to accelerate the digital transformation of healthcare systems and increase their interoperability. The project allows to create an adequate infrastructure base and the conditions required for future intensive performance of unique digitization work at the Institute, with the use of AI-based solutions, in order to enhance the provision of services and to streamline medical processes. The Mother and Child Institute cooperates with Microsoft Research on the world's first project using artificial intelligence in the early detection of genetic kidney defects in fetuses. The use of artificial intelligence, machine learning, IoT and the cloud is part of the Institute's scientific and clinical strategy until 2024. In addition, the Mother and Child Institute in Warsaw has implemented another component of the IC Pen system, thus enhancing its ability to create digital medical records while retaining their legal validity. Until now, digitization of patient consents, forms and other medical documents requiring a written consent to be granted by the patient has been done with the use of digital pens integrated with the IC Pen system. The medical personnel and the patients were using the aforementioned devices and printed forms containing microprint. Such an approach meant they were creating a hard copy medical document and its digital counterpart with a biometric signature.

Thanks to EU funds, an ICT system was implemented at the Mother and Child Institute in mid-2018, as part of the project titled "Computerization of the Mother and Child Institute with the implementation of an electronic medical records management system and provision of online services."

An Electronic Medical Records system and an Electronic Document Circulation solution were implemented at that time. The project was performed in partnership with Samodzielny Zespół Publicznych ZOZ im. Dzieci Warszawy in Dziekanów Leśny, Samodzielny Publiczny ZOZ in Kołbiel, Samodzielny Publiczny ZOZ in Celestynów and Samodzielny Zespół Publicznych ZOZ in Wieliszew. Thanks to the introduction of the ICT system, patients and cooperating institutions have the opportunity to remotely handle matters related to the Mother and Child Institute. The electronic system allows the Institute to communicate with its patients in a more efficient manner. Such enhanced communication has also been established between doctors and the Institute's staff. The integrated treatment system will improve the Institute's work, the process of handling patients as well as exchanging information between doctors.

The Mother and Child Institute, as an institution actively implementing innovative solutions, has established an independent unit within its organizational structure (Artificial Intelligence and Innovative Medical Technologies Department) to remain, on an ongoing basis, in contact with suppliers and creators of the latest solutions and innovations affecting the operation of the entire hospital.

The Mother and Child Institute is fostering the vision of a green hospital by establishing relationships with companies committed to reducing the amount of medical waste, designing biodegradable materials, and redefining current ways of managing municipal waste.

By opening up to progress and the participation of young visionaries in the creation of innovations, the Institute of Mother and Child is the initiator of the "Mother and Child Startup Challenge" project pursued in a consortium with 4 other institutions in Poland (the "Polish Mother's Memorial Hospital" Institute in Łódź, the Provincial Specialized Children's Hospital in Olsztyn, the "Żelazna" Medical Center in Warsaw and the University Children's Clinical Hospital in Białystok).

This cooperation is one of the few initiatives in which state-owned medical institutions participate. In addition to identifying projects that focus on patient care and disease prevention, cooperation with innovative companies (startups) may solve many socio-economic problems. The cooperating hospitals focus on implementing effective administrative and logistical innovations that redefine the existing hospital management processes and align them with the Eco Hospital principle.

MD, PhD Justyna Król-Całkowska
Lazarski University Associate Professor

ADMISSIBILITY OF USING AI ALGORITHMS IN THE PROCESS OF MONITORING THE QUALITY OF HEALTHCARE SERVICES AND IN MANAGING GREEN HOSPITALS – LEGAL ASPECTS

INTRODUCTION

Artificial intelligence is defined differently, depending on the field in which the concept is used. Currently, many definitions of artificial intelligence exist, but the definition given by A. Kaplan and M. Haenleina stating that AI is "the ability of a system to interpret correctly data from the outside, learning from them, and using this knowledge to perform specific tasks and objectives through a flexible adaptation" [1] deserves particular attention. In order to define the concept legally, one needs to refer to the Communication from the Commission entitled "Artificial Intelligence for Europe' (COM/2018/237) and dated 25 April 2018. In that specific document addressed to the European Parliament and the European Council, the European Economic and Social Committee and the Committee of the Regions have defined artificial intelligence as "systems that display intelligent behaviour by analysing their environment and taking actions – with some degree of autonomy – to achieve specific goals' [2]. Artificial intelligence has recently become a very popular topic that is widely commented on. It is vital to emphasize the difference between AI and complex activities performed by computer programs or electronic systems. Actions taken by the latter do not involve any decision-making in situations in which external variables are encountered that have not been foreseen by the program/system developer. AI algorithms, however, have the ability to take action on their "own" or (depending on the situation) are capable of modifying decisions to adapt them to the nature of the external variables, based on the new circumstances encountered. Systems supporting diagnostic and therapeutic decisions based on data concerning a patient's health (e.g., decision-supporting applications relying on medical imagery and applications supporting oncology diagnostics) may be considered good examples of AI solutions. The catalogue of AI systems does not include programmes and equipment which solely enable surgical procedures to be performed in a highly precise manner or which allow to perform complex processes (e.g. robots used in operating theatres).

In healthcare settings, AI algorithms are not used on a wide scale yet, inter alia due to the following reasons: the lack of stakeholders' confidence in the quality and effectiveness of AI algorithms, the lack of a uniform regulatory framework and the lack of an ethical framework guaranteeing that AI algorithms would respect human values. The general principles guiding the approach to legal aspects of artificial intelligence are described in the European White Paper on Artificial Intelligence: a European approach to excellence and trust [3] published by the European Commission on 19 February 2020. The document identifies a new European approach to the development of artificial intelligence that is based on excellence- and trust-related criteria. Although the White Paper is not a legal act as such, being merely a collection of ideas and aspirations, it sets the course for future legislative changes in the European Union. The European Commission strongly supports the human-oriented approach to the development of artificial intelligence and emphasizes that algorithms are intended to serve people, not the other way round. In the opinion of the European Commission, when establishing a legal framework ensuring ethical development of artificial intelligence, an overriding role of humans needs to be guaranteed. It needs to be stressed that the White Paper refers to two key criteria concerning artificial intelligence: excellence (an ecosystem of excellence) and trust (an ecosystem of trust).

Adoption of the excellence criterion is expected to lead to the establishment of a single legal framework for artificial intelligence in the EU, remaining in effect on national and regional levels. The other criterion is intended to boost social confidence in artificial intelligence. With that borne

in mind, it must be stated that after publication of the White Paper, the document has been subject to review and consultation in academic and business communities and in the civil society. The authors of the document entitled "Artificial intelligence development policy in Poland 2019-2027" drawn up in the Ministry of Digitization [4] clearly emphasize the importance of the human centric approach which aims to ensure that human values remain crucial in developing, implementing, using and monitoring artificial intelligence systems. In the European Parliament's resolution of 16 February 2017, a suggestion was made to offer, in the long term, a special legal status to robots that would be considered electronic persons who are responsible for repairing any damage they may cause. The robot would be making autonomous decisions or interacting independently with third parties. This means that a new legal category of "electronic persons" – other than natural, legal or statutory persons – could be created.

REGULATIONS ADOPTED BY EU DECISION-MAKING INSTITUTIONS

The use of AI algorithms, including in the process of managing the operation of entities providing therapeutic services, requires the implementation of suitable ethical standards and a legal framework providing for liability for any related damage. The decision-making institutions of the European Union have issued a number of documents relating to the legal and ethical aspects of functioning of artificial intelligence. The ones of the greatest significance include the following:

1. **Resolution of the European Parliament of 20 October 2020 containing recommendations for the Commission on framework of ethical aspects of artificial intelligence, robotics and related technologies (2020/2012(INL)) [5].**

Behind the legislative initiative stands the call to the European Commission to present a new legal framework laying down the ethical and legal principles to be followed when developing, implementing and using AI, robotics and related technologies in the EU. Building EU citizens' trust to AI based on a well-understood ethical principle is considered crucial. The consolidated text adopted by the European Parliament states that the legal framework for AI ethics should be established and based on union law, the Fundamental Rights Charter and international human rights law. It should apply, in particular, to high-risk technologies, with a view to establish different standards across the EU. It was stressed that future legislation should be developed in accordance with a number of guiding principles: man-oriented and man-made artificial intelligence ("human – centric" and "human – made" AI), security, transparency and accountability, protection against prejudice and discrimination, right to equitable remedy, social and environmental responsibility, privacy honouring and data protection. In its resolution, the European Parliament has repeatedly stressed the overarching objective of achieving a greater growth of the well-being and freedom of individuals ("human — centric approach").

2. **Resolution on intellectual property rights aspects of AI – European Parliament resolution of 20 October 2020 on intellectual property rights in the field of development of artificial intelligence (2020/2015(INI)) [6].**

In accordance with the resolution published by the European Parliament, as far as intellectual property rights are concerned, a crucial distinction must be made between a man's work supported by AI and work independently created by AI. Work created by AI autonomously requires that regulations on the protection of intellectual property rights be implemented, providing for such matters as ownership, inventions, suitable remuneration, as well as potential market concentration issues.

3. **European Parliament resolution of 20 October 2020 with recommendations for the Commission regarding the system of civil liability for artificial intelligence (2020/2014(INL)) [7].**

One of the motives behind the abovementioned regulation was the need to adapt the current system of liability for damage to the changing technological realities . In the recommendations, the potential of AI-based technologies that will be capable of revolutionizing almost any sector of the economy, including the healthcare industry, and that will impact our approach to environmental and climate protection, was recognised. The report also points out that AI does not have its own personality or human conscience, thus structuring the discussion on the need of awarding legal personality to such systems. According to the authors of the report, only a small portion of AI systems poses a real threat, as other solutions are progressing slowly. The introduction of liability-related regulations is, however, crucial for businesses and for the stability of the economy as a whole. Legal certainty is one of the main factors impacting investment and business decisions. Therefore, recommendations presented in the

report introduced a breakdown of AI systems into “high risk” and “other” AI systems.

The resolution indicates that the lack of transparency, as well as the autonomy of AI systems can make it difficult, in practice, to link specific damage caused by AI to actions taken by humans or their decisions at the stage of designing the system. Furthermore, it was stressed that whether AI systems remain under control of an operator should be an important factor when determining liability. The greater the risk of AI, the greater the threat to such protected values as life, health and property. Therefore, the resolution calls for the creation of a comprehensive and strict liability system for high-risk autonomous AI solutions. The operator of a non-high-risk system may be held liable. The European Parliament is of the opinion that when determining whether an AI system poses a high risk, account should be taken of the sector in which the action is taken and the nature of the action itself should be given consideration as well. The Parliament also points out that the interaction between the severity of potential damage, the likelihood that a given risk will cause damage and the way in which AI is used should be borne in mind as well.

4.

Draft EU resolution on artificial intelligence (Artificial Intelligence Act). Proposal for a regulation of the European Parliament and of the Council laying down harmonised rules on artificial intelligence (Artificial Intelligence Act) and amending certain union legislative acts; COM(2021) 206 final, 21.4.2021 [8].

In the draft regulation, a great emphasis has been placed on high-risk AI systems. The purpose of the regulation is to lay down basic rules that will ensure that artificial intelligence systems used in the EU are safe, transparent, ethical, impartial and that they remain, throughout the entire development and operation cycle, controlled by humans. The draft document provides for the cooperation between the Commission and the Member States on one side and European standards organizations (ESOs), international standards development organizations (ISDOs) and all stakeholders on the other, to ensure timely adoption of harmonized standards which are necessary for the enforcement of specific requirements and obligations set forth in the legal frameworks referring, in particular, to high-risk AI systems.

5.

Coordinated Plan on Artificial Intelligence – Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions – Coordinated Plan on Artificial Intelligence (COM (2018) 795 final)) [9].

The document highlights the importance of strengthening the credibility of AI and related technological solutions. Building the European data space needed for AI requires the creation of an appropriate infrastructure and a well-functioning data ecosystem which has to be based on trust. In 2020, the Commission started developing a common database of diagnostic images sourced from the healthcare sector. In addition, AI's cyber security solutions will be supported. The EC pointed out that the development of artificial intelligence in Europe must be ethical and human rights-compatible.

6.

The Commission communication "Artificial intelligence for Europe", COM(2018) 237 final, 25.04.2018 [10].

7.

Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – building trust in human-centric artificial intelligence, COM (2019) 168 final, 08.04.2019 [11].

JUSTIFYING THE USE OF AI IN MONITORING THE QUALITY OF AND MANAGING GREEN HOSPITALS

There is no doubt that AI algorithms can be effectively used in the healthcare sector, also to manage the operation of its facilities. In the context of this document, management should be understood as supporting processes that are directly linked assessing the quality of services provided, analysing and assessing greenhouse gases emissions, assessing energy efficiency, optimizing the use of medicinal products and medical devices, estimating the costs of medical transportation, monitoring the frequency and nature of adverse events and preventing these from reoccurring, optimizing the treatment of medical waste and assessing patient safety. In addition to management as such, the use of AI algorithms is justified in a broader context as well. They may be used in taking therapeutic decisions, in supporting image-based diagnostics, tele-consultations, monitoring chronic disease therapies, as well as in evaluating long-term effectiveness of therapeutic activities.

As far as "quality of management" and "quality of the services provided" are concerned, reference should be made to the definition of those term created by Plato who stressed that "quality is a certain degree of excellence" [12]. According to the definition by Donabedian from 1980, "the quality of care is its expected ability to achieve the offer the greatest benefits possible, in line with the system of values of individuals and the society as a whole" [13]. The World Health Organization defines the quality of healthcare as the degree to which health services offered to individuals and populations increase the likelihood of achieving the expected treatment outcomes and demonstrate compliance with up-to-date and professional knowledge [14]. According to the position of the Polish Ministry of Health, "in high-quality healthcare, the use of medical, human, infrastructure-related and financial resources is organized in the most effective way possible. This means that measures are taken to meet the needs of the society related to disease prevention, promotion of health, diagnostic procedures, treatment and rehabilitation, and to ensure that the healthcare meets the applicable requirements concerning its safety, efficiency and effectiveness" [15]. The definitions presented above vary, but they share a common feature, namely a certain degree of excellence in achieving optimum outcomes and efficiency levels while ensuring maximum safety.

Regardless of which quality definition is chosen, the use of AI algorithms in managing healthcare entities offers the ability to optimize their operation, not only in terms of the quality of service provided, but also in terms of environmental and climate protection. The use of AI algorithms is a challenge that is addressed in amendments to Polish legislative acts, such as the Patient Health and Safety Act [16] and the draft bill on modernizing and improving the efficiency of hospitals [17]. In light of the above, one may conclude that the use of dedicated AI algorithms in managing healthcare institutions may optimize the quality of the services provided thereby. One may also state that the quality of health depends not only on the quality of medical services provided, but also on the quality of the environment in which they are rendered. It should be pointed out, however, that a transparent and safe use of AI algorithms in healthcare (including in the management of healthcare providers) depends, inter alia, on the following::

a. Definition of clear national rules concerning civil and criminal liability for negative consequences resulting from the use of artificial intelligence algorithms, including processes relied upon to identify entities (algorithm designer, user, and AI decision-making entity) responsible for the adverse effects resulting from the use of AI,
b. Definition of an ethical framework that optimizes people's trust in AI, including activities to eliminate the so-called digital discrimination,
c. Standardization of the quality of healthcare as a variable guiding changes in hospital care,
d. Periodic training for healthcare managers and medical staff focusing on the legal aspects of AI algorithms used by healthcare facilities to support management decision-making processes, as well as on insurance policies covering liability for civil law activities performed by high-risk AI algorithms,
e. Definition of the rules applicable to facilitating, processing and protecting personal data by AI algorithms,
f. Definition of rules concerned with the protection of intellectual property created by AI systems,
g. Elimination of prejudices (debiasing) against the use of AI algorithms, as well as identification of a catalogue of socially unacceptable use cases,
h. Development of a Code of Good Digital Practices defining general principles for the use of AI algorithms in healthcare settings , as well as in the protection of the environment and climate.

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Metropolitan Hospital Nairobi

GREEN HOSPITAL REPORT – METROPOLITAN HOSPITAL NAIROBI

INTRODUCTION

Since the establishment of the network of Metropolitan Hospitals in the mid-1990s, their founders – acting under the leadership of dr. K. K. Gakombe - have figured out that for a hospital to be successful, its operations need to be based on a digital environment, guided innovation and sound governance structures. These systems will foster predictive planning, efficient use of resources, and will contribute to elimination of fraud, waste, and abuse - including corruption. By joining UN Global Compact Network Kenya, we are ceasing the opportunity to improve our metrics, learn and benchmark against the best, as well as share our journey with the rest of the world.

Some of the Metropolitan Hospital's actions in upholding responsible business practices include:

1. Digitization

a. We are the 1st hospital in Kenya to have integrated our monthly health indicator reports with the system of the Ministry of Health. This project eliminates the financial and human costs and, once replicated, will save the country hundreds of millions of shillings.
b. The system of processing doctors' applications and credentials is performed 100% online. Other staff recruitment and onboarding processes have been digitized in more than 80%.
c. The Metropolitan is the only hospital in Kenya that develops its own digital products. The 360-degree Hospital Management Information Systems (HMIS) is a good example here. This particular solution has enabled the hospital to digitize all of its paper-intensive processes.
d. Our processes are more than 95% paperless.
   - The entire outpatient process is 99% paperless. A few insurance companies still use hard copy claim forms.
   - The process of ordering lab tests and delivering their results is 100% paperless.
   - The process of ordering X-ray images and delivering them to the hospital's patients is more than 95% paperless. Some patients require printed X-rays.
   - 100% of prescriptions used in outpatient processes are written and distributed online.
e. Paperless claim process: The majority of processes involving both inpatient and outpatient procedures are paperless. The Metropolitan Hospital Nairobi was among the 8 pilot sites that have successfully implemented this solution under supervision of the National Social Health Scheme.
f. Cashless transactions. More than 90% of payments made by patients are cashless. All amounts receivable and payable are settled without the use cash. This eliminates most of the risks related to fraud, misappropriation, and bribery.
g. Paperless product procurement, delivery, and dispatch processes. The procedure is automated and its capacity may be predicted. All orders are submitted and received electronically. Deliveries within specific departments and wards are controlled biometrically, meaning that the risk of lost stocks is eliminated.
h. Other digitized processes include but are not limited to Inpatient nurse notes, Patient food ordering, and Linen management.

Section summary

Although we have made considerable progress in terms of digitization, some documents are still used in their analogue form. These include, for instance, doctors' notes concerning inpatients. We are currently working on system improvements. The supply chain relies on manual documents which can be eliminated by integrating data with vendor systems.

2. Energy management

The hospital continues to expand and earmarks significant resources for new equipment and facilities. We are taking significant effort to ensure that economically feasible and environmentally safe practices are maintained. Our activities in this field include the following:

a. Use of daylight: almost all of our old and new buildings have big windows allowing us to rely on natural lighting and ventilation, thus eliminating the need for artificial lighting during the day and air conditioning.
b. Batch processing in energy-intensive areas.
   - CSSD
   - Laundry: washing machines
   - Laboratory: repeated chemistry tests for admitted patients

c. Use of LED light sources and motion sensors. All new buildings and renovated areas are equipped with energy-saving light sources. We have replaced more than 90% of bulbs with LED fixtures to save energy.
d. Water is heated using solar systems.
e. Blankets, bed covers and patient robes are dried in the open. Only light-weight and frequently used patient gowns and bed sheets are machine-dried, in batches.
f. We discourage our staff from using lifts.
g. When new equipment is sourced, its energy efficiency is given high priority.
h. Centralised password-controlled printing.

3. Circular economy

To eliminate environmental pollution generated while disposing of defective equipment and used materials, we have invested heavily in circular economy processes.

a. More than 90% of our lab equipment is leased.
b. All printers use A5 format sheets that are cut into 2 parts to maximize reuse.
c. The printing system is centralized. To lead by example, only one senior manager has access to a direct printer.
d. Most equipment is manufacturer-maintained and remains operational beyond its estimated lifetime.

Authors

Elijah Ongeri
Principal Author, Head of Nursing and Quality
Dr. K. K. Gakombe
Co-Author, CEO and Founder

We take this opportunity to appreciate the following persons leading our environmental and sustainability programs.

Sustainability leaders

- **Dr. K. K. Gakombe** (Founder, CEO and Chief Architect of IT Solutions and Digitization) - Plays a leading role in IT designs and digital transitions.
- **Catherine Njoroge** (Head of Operations - Plays a leading role in the hospital's environmental protection and energy conservation processes.
- **Kenneth Gaceru** (Head of Operations TMG PLC) - Is responsible for hospital design and construction works.
- **Kenneth Shikuku** (Chief Finance Officer) - Tracking financial transactions and approves environmentally sustainable projects only.
- **Robert Musyoka** (Lab Manager) – Spearheading lab integration and outsourcing.
- **Caroline Wambui** (Strategic Purchaser) – Is responsible for ensuring that all equipment and supplies are environmentally friendly.

Narodowy Fundusz Ochrony Środowiska i Gospodarki Wodnej

National Fund for Environmental Protection and Water Management

FINANCING PROJECTS AIMING TO FOSTER GOOD HEALTH AND WELL-BEING OF POLES

Multi-directional actions aimed at improving the quality of air in Poland are in fact a tremendous battle for the good health and well-being of the Polish society. Therefore, financial support offered by the National Fund for Environmental Protection and Water Management ("NFEPWM") to subsidize thermal modernization of hospital buildings, facilitate energy savings, improve energy efficiency of such buildings and to pay for the removal of hazardous waste from healthcare establishments has not only an environmental and economic dimension, but directly impacts the health of the population. People-, environment- and climate-friendly "green" hospitals and sanatoriums are one of the key goals of NFEPWM.

Recognizing the problem of high electricity and heating costs in buildings owned by healthcare providers/medical entities, the National Fund for Environmental Protection and Water Management launched, in 2016-2019, two priority programs supporting medical facilities: "Improving air quality. Part 2) Reduction of energy consumption in the construction industry" and "Energy efficient buildings Part 1) Reduction of energy consumption in the construction industry".

THERMAL MODERNIZATION, RENEWABLE ENERGY SOURCES AND ENERGY MANAGEMENT

Both programs are intended to subsidize projects concerned with the following: thermal modernization of hospitals, healthcare centers, nursing homes, hospices, and facilities other than ones in which 24-hour medical services are provided, such as outpatient clinics, laboratories, technical buildings, administration buildings, heat distribution networks connecting technical facilities (heat sources) with other hospital buildings. The buildings in question must be a part of a hospital complex.

Funds reserved for those programs are earmarked for financing such projects as thermal modernization of buildings (improvements consisting in upgrading thermal insulation of walls and in modernizing/installing district heating systems, domestic hot water systems, ventilation and air conditionings systems, as well as electrical systems), installing renewable energy sources and implementing energy management systems. As many as 56 beneficiaries have taken advantage of the subsidies offered under the former of the programs. It is impossible to list all of them here, but it is important to note that apart from well-known metropolitan medical facilities, such as the Children's Memorial Health Institute In Warsaw, the Institute of Mother and Child, the Central Clinical Hospital of the Ministry of Interior and Administration, the Provincial Specialistic Hospital in Wroclaw, the Professor Stanisław Szyszko Independent Public Research Hospital Number 1 in Katowice or the Independent Provincial Polyclinical Hospital in Szczecin, financial support has been also provided to medical facilities located in the former voivodeship capitals (such as Legnica) and smaller towns being county capitals (e.g. in Chojnice, Łęczyca, Kłodzko, Kraśnik, Miechów, Pruszków, Racibórz, Słupca, Świdnica, Turek, Września, Żyrardów and many other towns and cities). The subsidies were also received by facilities located in smaller towns and by specialist establishments, such as the Independent Tuberculosis and Lung Diseases Health Care Centre in Adampol, the Silesian Centre for Rheumatology, Rehabilitation and Prevention of Disability in Ustronie or the Professor A. Kępiński Specialist Psychiatric Health Care Center in Jarosław. Financing under the latter of the two NFEPWM priority programs listed above has been provided to medical facilities of various types, profiles and sizes as well. These included the Cardinal Stefan Wyszyński Cardiology Institute in Warsaw, the Tuberculosis and Lung Diseases Institute in Warsaw, the Świętokrzyskie Oncology Centre – Independent Public Health Centre in Kielce, the Holy Spirit Specialist Hospital in Sandomierz, the Municipal Hospital in

Rabka-Zdrój or the Klara Jelska "Revival" Specialist Hospital for Lung Diseases in Zakopane.

Apart from the obvious social and economic benefits, the NFEPWM expects that the implementation of both programs will also contribute to achieving measurable environmental effects.

In reference to the program entitled: "Improving air quality Part 2) Reduction of energy consumption in the construction industry", measurable environmental effects are expected to be achieved by increasing the amount of energy generated from renewable energy sources by 100,000 MWh/year, reducing the use of primary energy by 526,500 GJ/year (145,250 MWh/year) and reducing CO_2 emissions by 46,800 Mg/year.

As far as the program entitled "Energy efficient buildings. Part 1) Reduction of energy consumption in the construction industry" is concerned, the expected environmental effects are as follows:

- reduction in the use of primary energy by 1,576,000 GJ/year (437,780 MWh/year).
- reduction in CO_2 emissions by 154,700 Mg/year.

GOOD CLIMATE FOR RESORT/SPA TOWNS

Having finished accepting applications for the "Energy efficient buildings. Part 1) Reduction of energy consumption in the construction industry" program, the National Fund for Environmental Protection and Water Management is now supporting beneficiaries form those regions of Poland in which sanatorium facilities are located, although the financial support offered relies on subsidies available under another program entitled "Climatic Health Resorts. Part 2) Supporting energy efficiency in public buildings in health resort communes". The objective of the program is to improve air quality and reduce greenhouse gas emissions in resort towns and in the adjacent protected areas by investing in energy efficiency and increasing the amount of energy from renewable energy sources (RES).

As part of the program, advanced thermal modernization projects are executed in public buildings located in resort towns and in the adjacent protected areas. The beneficiaries of the program may include local government entities or commercial companies in which such entities hold 100 percent of shares and which were established for the purpose of fulfilling the statutory duties of local government entities.

INCREASING ENERGY EFFICIENCY WITH EU FUNDING

With the concept of 'green hospitals' in mind, the National Fund relies also on European funding to achieve this objective, as exemplified by the implementation of sub-measure 1.3.1 'Supporting energy efficiency in public

buildings', under the Operational Program Infrastructure and Environment (OPI&E) 2014-2020. Using EU money, the National Fund signed (on 10 August 2021) a funding agreement with the Central Clinical Hospital of the Ministry of the Interior and Administration in Warsaw. Pursuing a project entitled 'Improving energy efficiency in the buildings of the Central Clinical Hospital of the Ministry of Interior and Administration in Warsaw', this nationally renowned medical institution will receive PLN 48.5 million under the EU Cohesion Fund. The scale of the subsidy is substantial, given that the total cost of the project is PLN 52.2 million.

The project will be completed by 31 December 2023. As many as 13 facilities of the Central Clinical Hospital of the Ministry of Interior and Administration (hospital buildings: A, B, C, D, E, F, I, Ł, as well as storage building C-6, medical clinic Ł-2, office building R, administration and office building S and technical and office building T) will undergo thermal modernization. The scope of the work includes, inter alia, insulation of external walls and ceilings, replacement of windows, luxro-frames and external doors, replacement of the central heating system (including modernization of the thermal center), replacement of the domestic hot water system, modernization of the ventilation system, replacement of circulation pumps, installation of energy-efficient light sources ones and installation of an energy management system.

The aim of this project is to reduce atmospheric pollution and increase the energy efficiency of the buildings. It is estimated that the comprehensive thermal modernization of the facilities will reduce greenhouse gas emissions by more than 2,500 tons of CO_2 equivalent/year (to be precise: 2,542.85 tons of CO_2 equivalent/year) and will lower energy consumption by 24,802.16 GJ/year.

(NON)HAZARDOUS HOSPITAL WASTE

In addition to issues related to energy efficiency of healthcare facilities, from an environmental point of view, efficient and effective disposal of hospital waste which may pose a threat to people and the environment, is equally important. NFEPWM's program 2.1 'Rational waste management, Part 2) Waste management installations' provides for the transfer of funding - in the form of grants and/or loans - for installations neutralizing medical or veterinary waste by incineration. Undertakings involving the construction or expansion of such incineration plants may receive support in the form of a grant covering up to 50% of eligible costs, not exceeding PLN 50 million, with the proviso that the amount of the grant must not exceed the amount of the loan granted by NFEPWM for the same undertaking.

If the installation processes fuels or waste other than medical or veterinary waste, the intensity of co-financing is reduced in proportion to the share of the mass of medical and veterinary waste in the total mass of thermally processed waste and fuels. Beneficiaries of the above-mentioned program may include, among others, independent public healthcare facilities dealing with managing medical waste. The call for applications ends on 30 June 2023. Two applications (for a loan and a grant) have been received so far, asking for co-funding a project entitled 'Construction of a new installation for the neutralization of hazardous waste through its thermal conversion with co-generation of energy at the J.K. Łukowicz Specialist Hospital in Chojnice'. The applications are currently undergoing environmental and technical screening.

In recent years, NFFEPWM has supported investments concerning the disposal of hospital waste implemented by a number of large and important medical facilities across Poland, including the Maria Skłodowska-Curie Oncology Institute in Gliwice (modernization of the thermal medical waste disposal system), the Voivodship Specialist Hospital in Białystok (modernization of the hospital waste incineration plant), the Clinical Hospital No. 1 of the Pomeranian University of Sciences and Humanities in Szczecin (construction of a medical waste incineration plant), the Karol Szymanowski Voivodship Hospital in Chojnice (construction of a medical waste incineration plant), the Cardinal Stefan Wyszyński Hospital in Warsaw (construction of a medical waste incineration plant), the Cardinal Stefan Wyszyński Voivodship Hospital in Łomża (modernization of an incineration plant together with a medical waste collection system), ZOZ in Gryfice (modernization of a thermal line for the neutralization of medical and veterinary waste with energy recovery), ZOZ in Sandomierz (reconstruction of a medical waste incineration plant), Multispecialist Hospital in Jaworzno (modernization of radiological procedures and radiological diagnostics), ZOZ in Milicz (development of technical and technological documentation and modernization of a waste incineration plant). Subsidies were also received by voivodes who were overseeing the construction of a central incineration plant for hospital waste generated in units subordinated to Health Department of the Voivodeship Office in Tarnów, and the construction of a hospital waste incineration plant for the then Sieradz Voivodship at the ZOZ in Łask.

PFSz

The Polish Federation of Hospitals

THE IDEA OF GREEN HOSPITALS AND ITS IMPLEMENTATION BY THE POLISH FEDERATION OF HOSPITALS

According to the World Health Organization (WHO), climate change poses the greatest threat to public health in the 21st century. Air pollution alone contributes to 4.2 million premature deaths worldwide each year. Climate change affects the conditions in which people are born, grow, work, live, and age, impacting also their living conditions. The costs of healthcare related to climate change and pollution are estimated to equal $820 billion per year. Climate change may be considered from three perspectives:

1. Efforts towards decarbonization of healthcare
2. Climate change as a challenge/pressure affecting healthcare systems (e.g. natural disasters, ensuring continuity of care, mass events)
3. Impact on people's health and well-being.

Ad 1.)

Global healthcare systems are responsible for 4% of global CO_2 emissions – more that aviation or shipping industries. If the healthcare sector were a country, it would be the fifth-largest emitter of greenhouse gases in the world. Paradoxically, it is the healthcare sector - guided by the Hippocratic principle of "first, do no harm" - that is responsible for such a significant carbon footprint. This is caused by many reasons, including the specific nature of the healthcare sector, the round-the-clock nature of its operations, the requirement to use air conditioning systems and to provide suitable medicine storage conditions, as well as the need to rely on highly specialized medical equipment. It is also important to note that many hospitals have outdated and energy inefficient infrastructures. Direct emissions from healthcare facilities account for 17% of the sector's global footprint. Indirect emissions from purchased electricity, medical gases, air conditioning, and heating account for another 12%. And the largest share of emissions (71%) is attributed to the healthcare sector's supply chain (production, transportation, use, and disposal of goods and services required by the industry).

Ad 2.)

The consequences of extreme weather events have a negative impact on infrastructure (media, transportation, communication), which can negatively affect patients' access to emergency and planned procedures. They may also disrupt supply chains, lead to shortages of medical equipment or supplies for patients, providers, and producers.

Ad 3.)

According to The Lancet Countdown 2020 report, the deteriorating global climate situation is responsible for:

1. a 53.7% increase in deaths caused by heat in people aged over 65
2. 3.01 million premature deaths caused by heart and lung diseases associated with air pollution caused by particulate matter.

We know that climate change is already exacerbating a range of health problems worldwide. Healthcare is on the front line of climate change, meaning it has a unique opportunity to play a leading role in combating climate change – a phenomenon that The Lancet has called the biggest health threat of the 21st century. To protect local and global health from climate change, the world must move towards an economy based on clean, renewable, and healthy energy. Healthcare can contribute to this effort by reducing its carbon footprint and promoting green practices, as well as by advocating for policies that promote a low-carbon economy.

Hospitals, health centers, and healthcare providers are the first to respond to extreme weather events and must build their functional resilience in order to keep operating and to serve their communities during climate-related disasters. Low-carbon healthcare systems can mitigate their impact on the climate, simultaneously saving money and leading by example. By strengthening systemic resilience, healthcare may help prepare for the ever increasing impact of climate change. And by playing the role of a society leader, the healthcare sector may help shape a vision of the future with healthy hospitals and

healthy people living on a healthy planet. At this critical moment, it is time to take action to protect public health from the effects of climate change.

The challenge and the related commitments are based on three main pillars:

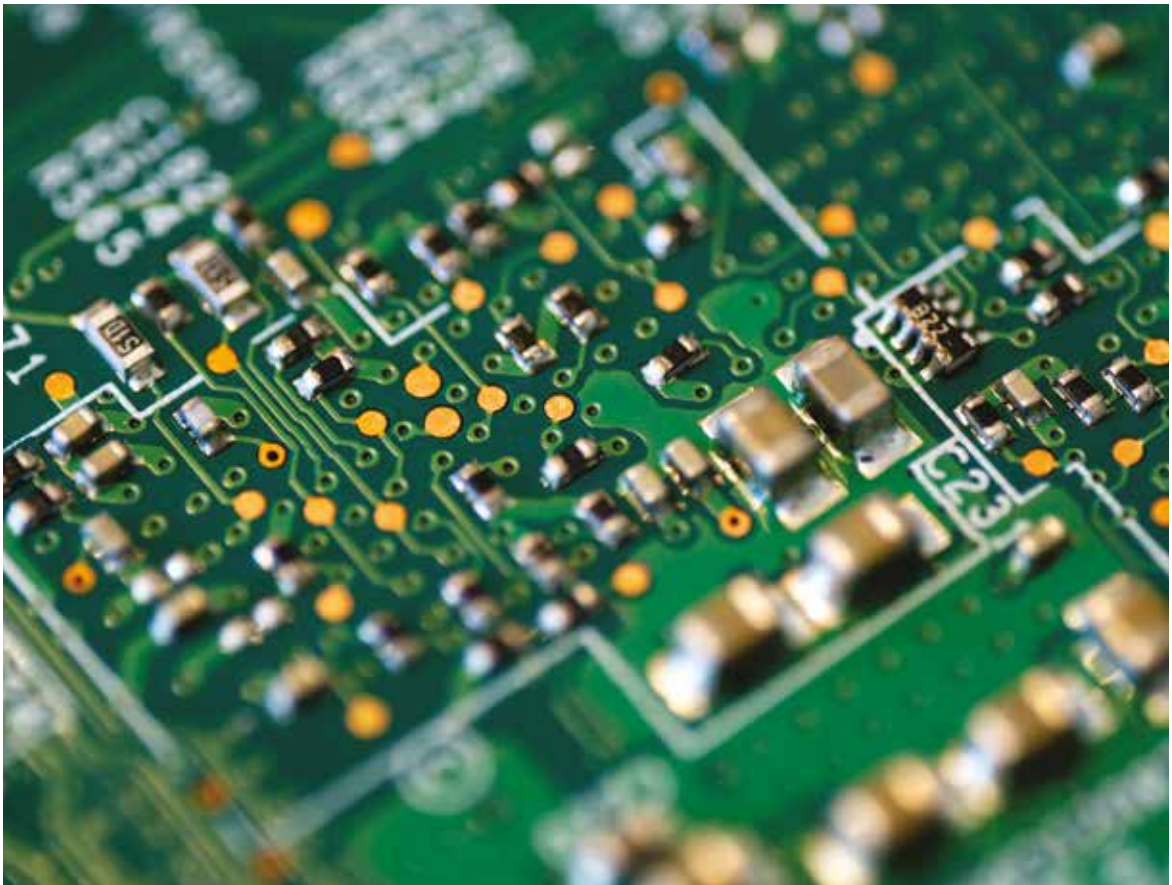
1. **Mitigation** – reducing the healthcare sector's own carbon footprint and/or supporting low-carbon healthcare
2. **Resilience** – preparing for extreme weather events and changing disease patterns
3. **Leadership** – educating healthcare staff and the public while promoting policies aimed at protecting public health against climate change.

The Green Hospital approach is based on a comprehensive framework of 10 interconnected goals for the health sector enabling it to promote more sustainable development and environmental health.

The Green and Healthy Hospitals program aims to support existing efforts worldwide to promote greater environmental stability in the healthcare sector, thus strengthening healthcare systems worldwide.

We have defined 10 goals of the program listed below:

1. **LEADERSHIP** – prioritizing environmental health
2. **CHEMICALS** – replacing harmful chemicals with safer alternatives
3. **WASTE** – reducing, processing, and safely disposing of medical waste
4. **ENERGY** – improving energy efficiency and promoting renewable energy
5. **WATER** – reducing water consumption in hospitals
6. **TRANSPORTATION** – improving transportation strategies for patients and staff
7. **FOOD** – purchasing and delivering sustainable, healthy food
8. **PHARMACEUTICALS** – safe management and disposal of pharmaceuticals
9. **BUILDINGS** – supporting green and healthy hospital design and construction practices
10. **PROCUREMENT** – purchasing safer and more sustainable products and materials



DIGITIZATION AND LATEST TECHNOLOGIES FOR SUSTAINABLE HOSPITALS. MODERN AND ENVIRONMENTALLY FRIENDLY SOLUTIONS AND STATE-OF-THE-ART HOSPITAL EQUIPMENT

Digitalization and innovative technologies can significantly contribute to supporting the green transition of healthcare facilities and may help raise awareness among healthcare institutions about the prospects of using digital technologies in the entire operational chain of environmentally friendly hospitals. Green and sustainable hospitals require a broader perspective on the optimization of carbon dioxide emissions generated by hospitals throughout their entire life cycle, and on the environment in which they operate. Modern and ecological solutions, as well as suitable hospital equipment, play a crucial role in fostering sustainability.

Therefore, there is a need to analyze the digital activities of a medical facility and their impact on reducing CO_2 emissions from two points of view, namely those of embedded and operational carbon. The former is related to the hospital as a building and its internal workings, while the other to the daily activities of hospital personnel performing medical procedures.

1.

Embedded carbon, related to the hospital as a building, is the amount of carbon dioxide (CO_2) emissions associated with the materials and construction processes or the infrastructure's life cycle. It includes all CO_2 emissions generated during the production of building materials (extraction of materials, transport to the manufacturer's, production processes), transporting these materials to the construction site, and the construction practices applied. There is an opportunity to optimize CO_2 emissions and achieve the status of a Green Hospital from step one, i.e. from the building's design and construction stage, all the way to the use of digital technologies, such as BIM (Building Information Management Systems) and VDC (Virtual Design & Construction) which guarantee a holistic approach to creating and managing information related to the facility being constructed.

Harnessing the model of a digital smart hospital and using cloud-based platforms, BIM integrates well-organized, multidisciplinary data to create a digital representation of a given asset throughout its entire life cycle, from planning and design to construction and operation stages. Such an approach allows to create, at an early stage, a digital, i.e., a digital replica of the physical building and its processes. The designer can see what the building will look like using virtual reality (VR) or augmented reality (AR) and can also assist medical staff in planning the optimal functional layout of operating rooms and walkways. The staff may also become familiar with a replica of the future hospital thanks to its virtual, 1:1 scale model.

Such a digital hospital design was used when working on the Swedish New Karolinska Solna University Hospital (NKS). Thanks to the use of digital solutions, the functional side of this facility was worked on with a particular emphasis placed on work ergonomics and efficiency of logistic processes. The new Karolinska Solna Hospital is a technologically advanced medical facility with highly optimized clinical functionality, which makes it one of the most sustainable university hospitals in the world. Models relying on digital BIM technology have facilitated the construction of the hospital in accordance with the requirements of the LEED GOLD international standard.

2.

Operational carbon – is the carbon released in the daily operations of a hospital, understood as the building and its medical environment. Its sources include all areas of a digital, smart building, including the Building Management System (BMS), lighting, HVAC, IoT components supporting the building's digital processes and reducing energy consumption and, thus, limiting CO_2 emissions. The integration of all technological solutions listed above, achieved by connecting theses to digital systems and applications, enables to create a complementary Building Automation System (BAS) for the hospital. The BAS system helps healthcare facilities find ways to reduce costs, increase staff efficiency, and operate their systems in a safe manner, simultaneously ensuring a high level of resilience and redundancy.

Smart IoT sensors connected to the BMS may support lighting control functionalities, real-time location services, and may generate data on the use of space. They can act as a lighting control system while providing data

for additional hospital applications. As the system is wireless, it also reduces installation costs (less wiring is required). The Desigo CC System (by Siemens) is an example of such a solution.

These digital solutions make it possible to optimize CO_2 emissions and reduce energy consumption. Two noteworthy examples of facilities at which such systems have been installed include the following:

1. **Chang Gung Memorial Hospital in Taiwan** – it was the first hospital in Asia and the second in the world to receive the platinum LEED for Healthcare certificate. Currently, the hospital is 42% more energy-efficient than a typical building. It saves 2 million kWh of electrical energy each year and reduces CO_2 emissions by 1,224 metric tons.

2. **Ankara City Hospital** – operating at one of the world's largest hospital campuses, the Desigo CC system monitors and controls 22 subsystems with over 800,000 data points, including lighting, fire protection, HVAC, and access control systems.

Real-time location services (RTLS) are another example of a solution demonstrating how digitization can significantly impact the efficiency of a hospital and its CO_2 emissions. The specific use cases of RTLS systems include the following:

1. **Asset tracking** - since the average equipment utilization rate is less than 40%, hospitals purchase or rent too much equipment; asset tracking helps optimize their utilization thus reducing initial and maintenance costs.

2. **Patient flow optimization** - it gives patients and staff an insight into all stages of treatment and shows the patient's status in the process.

3. **Space utilization monitoring** - accurate information about space utilization is necessary to make informed decisions about optimizing the use of existing space.

While deploying digital technologies, another important aspect should be taken into consideration as well, namely cybersecurity of all digital systems deployed in a hospital. Security incidents may include data breaches as well as disruptions affecting operation of IT system and business functions.

The implementation of blockchain-based solutions will allow for full access to the history of processes, supporting management and optimizing specific tasks by relying on artificial intelligence algorithms. Such an approach will significantly reduce the duration of hospital stay, thus contributing to a drastic reduction in the carbon footprint generated by caring for that patient in the hospital.

MAIN SOURCES OF GREENHOUSE GASES IN THE HEALTHCARE SECTOR. DECARBONIZATION OF THE SUPPLY CHAIN

Waste disposal is an important element of emissions within the supply chain, as it accounts for up to 90% of the overall burden in the healthcare sector. Transporting and disposing of waste generates a significant amount of carbon footprint, as well as associated labor costs and lost opportunities, such as utilizing municipal and clinical waste in internal processes: recycling for municipal waste and energy conversion for clinical waste, as well as non-recyclable organic fractions of municipal waste.

Implementation of a single energy-from-waste system that complies with EU regulations applicable to clinical waste created in the amount of less 10 tons per day will generate up to 750 kW of electricity per hour, saving up to 50% of costs. Most importantly however, it will generate a negative carbon footprint throughout the entire supply chain (see nst.agency offer[1]).

Recycling of personal protective equipment made of polypropylene, such as masks, caps, gowns, disposable bed sheets, or curtains used in triage rooms or during preliminary patient examinations at intensive care units, results in an 85% reduction in CO_2 emissions and benefits the planet by reducing resource consumption and limiting the amounts of products and materials within the hospital's supply chain (see, for example, the Thermal Compaction Group offer[2]).

As far as medicines and the entire supply chain are concerned, the key actions that may be undertaken there include optimizing prescription-related practices, replacing high-emissions products with their low-emissions alternatives (especially low-emissions inhalers and anesthetics), streamlining production and waste processes, reducing dependence on disposable products, introducing transparent reporting practices concerned with carbon dioxide emissions, and implementing new national nutrition standards binding in the healthcare sectors and applicable to patients, staff, and visitors. All suppliers may also commit to meet or exceed zero-emissions targets before the end of the decade.

1 https://ewolucjasmieciowa.pl/
2 https://www.tcgsolutions.co.uk/

GREEN ENERGY FOR HOSPITALS + ENERGY EFFICIENCY

CLIMATE-NEUTRAL BUILDINGS AS A CONTRIBUTION TO A CARBON-FREE GLOBAL ECONOMY

Climate change and environmental degradation pose a threat to Europe and the rest of the world. Meanwhile, Europe aspires to be the first climate-neutral continent. To meet these challenges, the European Green Deal has been created. It aims to help transform the EU into a modern, resource-efficient, and competitive economy that will achieve net-zero greenhouse gas emissions by 2050.

The European Commission has adopted a package of legislative proposals to adapt EU climate, energy, transport, and tax policies to achieve the goal of reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels. These proposals are currently being modified in the REPower EU plan, in connection with the adoption of a new goal to become independent of fossil fuel imports from Russia before 2030. The achievement of this goal is to be based on two pillars: diversification of natural gas supplies from sources outside Russia and faster elimination of fossil fuels used in homes, buildings, industry, and energy systems, mainly by accelerating the improvement of energy efficiency and increasing the use of renewable energy sources. New legislative proposals will be presented in 2022 in the form of the European Union directive on Energy Efficiency First.

On February 9, 2022, the Polish government adopted the Long-Term Renovation Strategy (DSR) to support the renovation of the national building stock. The DSR specifies the actions necessary to ensure high energy efficiency and low emissions of private and public buildings in Poland by 2050. The recommended renovation scenarios and guidelines presented in the strategy will contribute to a cost-effective transformation the national building stock, with the overarching goal to reduce energy consumption nearly to zero.

In connection with the above-mentioned policies, building owners and managers, including hospitals, should focus on minimizing energy demand while optimizing the use of renewable energy sources and the possible utilization of hospital-specific transformation and energy generation processes, such as those relying on waste.

As far as the construction of buildings in Poland is concerned, provisions of the Regulation of the Minister of Infrastructure of April 12, 2002 on the technical conditions to be met by buildings and their locations (Journal of Laws of 2019, item 1065) apply. The first requirement concerned with energy performance has the form of maximum heat transfer coefficient values applicable to building walls. The current values for an indoor temperature of 20°C have been in effect since December 31, 2020, and are as follows: external walls 0.20 W/(m^{2}K), roofs 0.15 W/(m^{2}K), floor slabs 0.3 W/(m^{2}K), windows 0.9 W/(m^{2}K), and doors 1.3 W/(m^{2}K). If buildings are modernized, designers are required to meet those requirements for each of the elements listed above.

The second requirement has the form of the maximum primary non-renewable energy demand (EP). The value of this indicator depends on the type of the building and equals 70 kWh/(m^{2}year) for single-family buildings without an air conditioning system, 65 kWh/(m^{2}year) for multi-family buildings without an air conditioning system, and 190 kWh/(m^{2}year) for healthcare buildings. If the buildings are modernized, it is not necessary to meet this requirement, but the minimum value is recognized, in practice, as a guideline to be followed while designing modernized energy supply systems. In currently applicable legislation, a model recommending local closed-loop energy production systems has not been introduced yet, but such an approach should be considered in the future (e.g. energy from clinical waste).

According to data from the DSR, the primary energy demand of healthcare buildings in Poland ranges from 257-442 kWh/(m^{2}year), depending on the year of their commissioning. This means that currently applicable guidelines are exceeded 1.5-2.5 times. Consequently, the potential for improving energy efficiency and for using renewable energy in these buildings is immense.

In order to come up with an energy management program for healthcare buildings, aiming to minimize demand for heat, electricity, and other utilities, building owners and managers may rely on the ISO 50001 "Energy Management" standard. This standard allows to develop and implement an energy policy based on the facility's energy audit. Its systematic implementation enables to gradually achieve the goal of climate neutrality, understood as reducing energy consumption to the level that may be satisfied by emission-free energy sources.

To improve the energy audit process, Building Information Modeling (BIM) is used, which completely changes the approach to designing, erecting and managing buildings. BIM, or information modeling, allows for continuous and immediate access to current project information and all costs associated therewith. Building Information Modeling (BIM) serves as the foundation for digital transformation in architectural, engineering, and construction industries.

In order to conduct an energy audit of a building and to implement BIM, it is necessary to deploy and properly use a Building Energy Management System (BEMS) which continuously informs about the consumption of resources by a given building and enables detailed technical and economic analyses to be performed in order to increase energy efficiency.

To conduct an energy audit of a building, a suitable methodology is relied upon to draw up a report presenting a comprehensive economic assessment of the potential improvements intended to minimize energy losses, reduce resource consumption and introduce building automation solutions. The process harnesses the latest knowledge and the best available computational tools, such as dynamic simulations that consider, for instance, objects creating shade in order to simulate the operation of internal systems and to introduce renewable energy sources.

A comprehensive energy audit of a building, performed using digital data as well as technical and economic analytical tools, becomes a convenient and necessary instrument for investment planning, for securing financial resources and for managing, on an on-going basis, the use of energy by a given facility and its users.

While buildings intended for healthcare purposes, built in accordance with current requirements, are characterized by low energy consumption, the modernization of existing buildings required to meet the same standards (or ones that are better suited to objectives of the climate policy) is a difficult and complex task that requires interdisciplinary knowledge and experience. In order to achieve this goal, the instruments described above need to be used.

BMS (Building Management System), constituting a part of the previously mentioned ISO 50001 standard, is another solution facilitating hospital decarbonization, as it aims to introduce the so-called Digital Twin. This model creates a smart building that communicates not only with doctors and administration staff, but also with patients, on-site equipment and, most importantly, allows to ensure proper conditions for the storage of medicines, dressings, and other consumables required for ongoing operations. Their ordering may be optimized using blockchain models, the pull-to-manufacture philosophy, and other AI-based solutions to ensure both cost- and environmental effectiveness of the hospital's operations.

HOSPITAL SURROUNDINGS – AIR AND WATER QUALITY, WASTE MANAGEMENT PROCESSES

CO_2 emissions produced by conventional incinerators, transportation of municipal and clinical waste, and lack or imperfection of appropriate waste management processes, all result in hospitals incurring enormous financial and emissions-related costs due to the lack of optimization of such processes by relying on recycling or on-site waste-to-energy conversion. Meanwhile, waste processed on-site generates energy, contributing to a reduction in energy demand and thus reducing the long-term demand for fossil fuels necessary to deliver energy.

An additional benefit of local energy generation systems is the resilience of hospital units to cost fluctuations and availability of energy from the market.

Urszula Szybowicz
COO Polish Hospital Federation

Michał P. Dybowski
New Science Technology Agency,
Chief Sustainability Officer,
Polish Hospital Federation

Joanna Szyman
President of the Board
of NEO Hospital Group

Ewelina Bogiel
Warsaw Cluster Cooperation Network

Andrzej Rajkiewicz
National Energy Conservation Agency

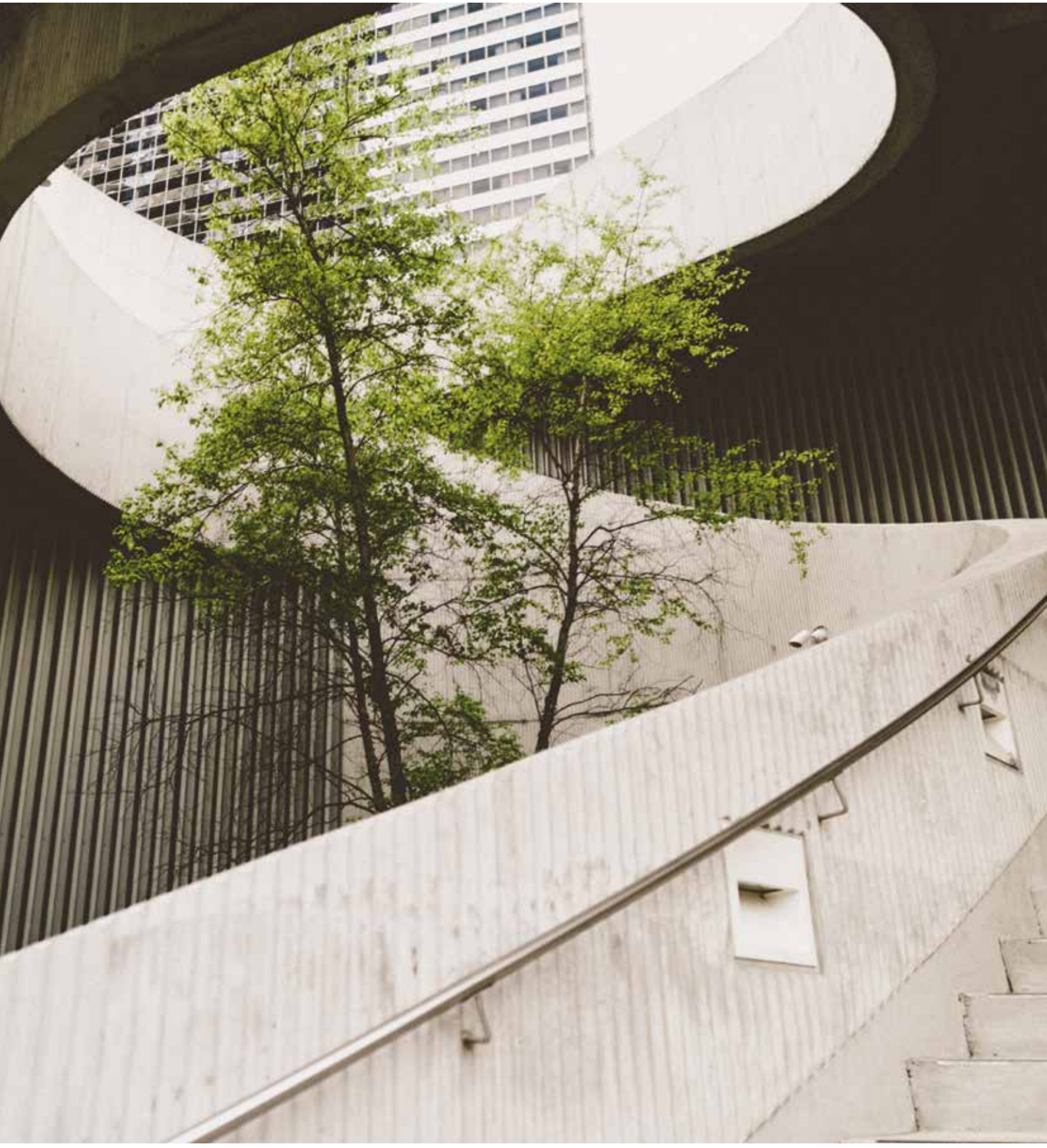
Anna Tryfon-Bojarska
Advisor at the Institute of Digital Affairs

Agata Miazga
Vice President of the Institute
of Digital Affairs

Jadwiga Pokrop
Project Manager at the Institute
of Digital Affairs

Ireneusz Wochlik
AI LAW TECH Foundation

Tomasz Gajewski
Microsoft



Joanna Szyman
President of the Board
NEO Hospital Group

GREEN HOSPITAL OF THE FUTURE – A SUSTAINABLE ENVIRONMENTAL DEVELOPMENT PROGRAM OF THE NEO HOSPITAL

Climate change significantly affects the conditions in which people are born, grow up, work, live, and age, impacting also their living conditions. According to the World Health Organization (WHO), air pollution contributes to 4.2 million premature deaths worldwide each year, and the total healthcare costs associated with climate change and pollution are estimated at USD 820 billion annually. At the same time, the healthcare sector itself contributes to this serious phenomenon, accounting for 4% of global carbon dioxide emissions. Direct emissions from healthcare facilities account for 17% of the sector's global footprint. Indirect emissions from purchased electricity, medical gases, air conditioning, and heating account for another 12%. And the largest share of emissions, up to 71%, comes from the healthcare supply chain: production, transportation, use, and disposal of goods and services needed by the sector. Hospitals, as facilities requiring large quantities of resources, consume enormous amounts of electricity, water, food, and materials to provide high-quality care. Therefore, it becomes crucial to promote environmentally sustainable approaches and measures that can have a positive impact on reducing hospitals' carbon footprint. At NEO Hospital, we base our actions on a sustainable development strategy and stive to continuously self-improve in order to meet, in the best way we can, the expectations of our patients and stakeholders, facing the environmental challenges in an act of solidarity with future generations.

WHAT IS THE SUSTAINABLE DEVELOPMENT STRATEGY OF NEO HOSPITAL BASED ON?

NEO Hospital's environmental strategy is part of its overall development strategy that has been in place since the hospital's establishment in 2019. In our view, "environment" and "development" are not separate challenges, but are linked by cause and effect. Consequently, our business goals are aligned with our social and environmental goals. The sustainable development strategy allows us to achieve sustainable and dynamic growth and strengthens our competitive advantage by optimizing long-term infrastructure operating costs, efficiently managing material consumption, and consciously implementing our procurement policy with environmental considerations in mind. We enjoy the trust of the local community and boost demand for our services by improving efficiency and quality by relying on the value-based healthcare (VBHC) model. Over the past three years, we have tripled our revenue. However, this significant growth in business activity did not require a proportional increase in resource use. For example, a 20% increase in the number of procedures (without changing the hospital's operational profile) has not led to an increase in the use of bed capacity or the operating room. How did we achieve this? We worked on efficiency and focused, inter alia, on the following:

1. Preparation of the hospital building and infrastructure
2. Selection of medical technologies that support minimally invasive procedures, allowing for shorter hospital stays and recovery periods (98% of procedures in our hospital are performed using minimally invasive techniques, including the use of the da Vinci surgical robot and augmented reality technology)
3. Support of digital IT systems, data security, and data interoperability
4. Human capital development (staff training and education)
5. Ensuring efficient communication with external and internal stakeholders
6. Building an organizational culture based on equality and balance.

NEO Hospital recognizes and understands the link between human health and the environment and demonstrates this through its management, strategy, and operations. We combine local needs with environmental actions and primary prevention practices, actively engaging in efforts to support the community, environmental health, health equity, and a green economy.

WHICH PROBLEMS AND CHALLENGES REQUIRED SPECIFIC SOLUTIONS?

Our strategy is based on interconnected business, social, and environmental sustainable development goals. The environmental goals we have set for ourselves relate to the following key areas:

- **ENERGY** - we manage energy efficiency, use natural energy solutions, and utilize secondary energy sources.
- **WATER** - we manage water consumption in the hospital to reduce it, use efficient and routinely checked water installations, modern cooling systems, and regularly analyze water quality.
- **CHEMICALS** - we avoid harmful chemicals and use their safe alternatives. We have developed policies and protocols for the use of chemicals and materials to protect the health of patients, workers, and the environment. We pursue our healthcare policies without using any mercury.
- **WASTE** - we reduce, sort, and safely dispose of medical and non-medical waste.
- **PHARMACEUTICALS** - we manage pharmaceutical safety and limit the use of medication.
- **BUILDINGS** - we support healthy building and landscape design concepts. The building is energy-efficient and ergonomic, equipped with systems allowing us to use natural energy sources, secondary energy sources, and LED lighting. We use high-reflectivity roofs and surfaces and permeable surfaces to reduce the effect of the urban heat island. We also manage rainwater and protect habitats.
- **MEDICAL EQUIPMENT AND TECHNOLOGY** - we use digital technologies and modern medical tools, including surgical robots, offering patients minimally invasive procedures, reducing hospital stays and recovery periods, and decreasing the use of drugs and materials. We use digital devices, cloud-based solutions, work with electronic medical records, and electronic document workflows (reducing document handling costs by approximately 75%, reducing the time spent searching for documents by approximately 90%, and reducing the costs of purchasing office materials by approximately 50%).
- **PROCUREMENT** - we purchase safe and more sustainable products and materials, audit the value chain and policies of our suppliers, and have adopted codes of ethics and supplier evaluation codes.

WHAT WERE THE KEY MILESTONES? WHAT ARE THE SIGNIFICANT AND LASTING RESULTS AND OUTCOMES?

We started by developing a sustainable development strategy and a set of complementary documents defining the priorities for expanding the range of healthcare services and for building our market position based on demographic and epidemiological data. Then, we agreed upon the above with our stakeholders, taking into account various social and environmental aspects.

Investment was the next step. We continuously invest in research and development to eliminate barriers hindering further innovation (over the past three years, the value of our investment in research and development accounts for approximately 20% of NEO Hospital's revenue). Strategic and operational plans and budgets reflect the management's commitment to a green and healthy hospital.

As part of the Living Lab, we have created opportunities for testing innovative solutions, including digital technologies harnessed in the operating theater of the Robotic Surgery Center. The program is dedicated to startups, academic environments, creators of innovative services and digital solutions that may find applications in medicine or solutions that improve the efficiency and safety of the hospital's internal processes.

We manage energy efficiency, use solutions allowing us to harness natural energy, reuse energy, and rely on LED

lighting. Our energy consumption is approximately 320 kWh per 1 m^2 (Global Green and Healthy Hospitals recommendations for green hospitals are 320 kWh/m2 or less[3]).

This year, we plan to install an additional PV system which will reduce our CO_2 emissions by 498 t (an amount that is equivalent to planting 23,016 trees). We estimate that the new installation will cover an additional 18% to 20% of our demand for energy from external sources.

Over 40% of the hospital's area is biologically active, positively affecting the well-being of patients and staff. There are 135 trees on the hospital grounds, which absorb approximately 900 kg of CO_2 annually.

In our hospital, 98% of procedures are performed using minimally invasive techniques, including the da Vinci surgical robot. Our center is currently responsible for 20% of all da Vinci robot procedures performed the Polish market. We have also implemented many other modern technologies that improve safety, precision, and shorten procedure lead time (e.g. the Carna Life Holo technology used in planning and during oncological procedures). The use of technology has allowed us to shorten the duration of the procedure by about 30%. Another example is the use of an echolaser (ultrasound-guided laser ablation system) in the treatment of benign thyroid nodules. This technology has allowed us to move from surgery in the operating room to a minimally invasive method performed on an outpatient basis. Our goal is to maintain high treatment effectiveness combined with a sustainable reduction in the number of surgical complications and elimination of the need for lifelong pharmacological substitution.

Minimally invasive procedures translate into a lower burden for the patient, shorter hospital stays, and faster recovery. This means that lower amounts of resources, including medication and materials, are consumed as well.

To promote minimally invasive techniques among medical staff, we have established the Center for Education and Professional Skills Development. Approximately 140 people have already participated in our training courses. This year, in collaboration with the Women in Surgery Foundation, we launched a pilot project aimed at improving access to education and facilitating professional development of women pursuing careers in surgical fields. In healthcare, we need balance, collaboration, and change to fully utilize the talent and ambitions of all individuals choosing to pursue a career in this sector. At the same time, we need changes that will allow us to take advantage of the opportunities arising from the development of new technologies, including surgical robotics, which support the work of medical staff. We strive to make positive changes in the social environment, caring for public health and the safety of future generations.

As part of the Polish Federation of Hospitals, we share our practices and are involved in the work of the Coalition for the Development of Medical Robotics and New Technologies, which is an expert center of excellence focusing on medical robotics, and a location where clinical partners as well as industry and science representatives meet and collaborate to promote the use of robotics and related technologies in healthcare.

Tomasz Gajewski
Project DOM

The Home Medical Care (DOM) project is a comprehensive remote health monitoring service for patients. DOM uses a pulse oximeter as a diagnostic tool and the Home Medical Care app to transmit and monitor patient data. Through the use of remote monitoring, patients can be treated at home, while doctors and consultants monitor their results around the clock. As part of the pilot program, we are also implementing additional diagnostic services, such as an electronic stethoscope, a telemedicine bracelet, or an e-spirometer.

The program's goal is not only to increase patient safety but also to streamline the work of general practitioners who may already use the Home Medical Care app to enroll non-COVID-19 patients into the program. The program offers the following services:

- measurement of oxygen saturation levels
- measurement of blood sugar levels
- measurement of blood pressure levels.

As a result, patients do not need to visit the doctor as often, since the doctor has access all monitored parameters, which translates into a tangible reduction in the burden on healthcare facilities. The solution relies on the Microsoft Azure cloud platform that is known for energy -efficient utilization of IT infrastructure.

Another interesting solution is the LIKAR app (https://likar.mz.gov.pl/) which allows to quickly diagnose patients and enables patients and doctors who do not speak the same language to communicate by digitizing their exchanges during the diagnosis phase. The app also allows the patient to describe their health status before the visit, optimizing the duration of the visit and allowing the doctor to conduct a medical consultation faster. The solution operates on the Microsoft Azure cloud platform that is known for energy-efficient utilization of IT infrastructure.

Digitalization aspects (including AI) in the context of decarbonizing infrastructure and working towards building a digital twin. An especially emphasized area within the intergovernmental initiative GAIA X, as part of the plan to build a digital twin of the entire planet Earth.

Context: Energy Performance of Buildings Directive

The Energy Performance of Buildings Directive (EPBD) is the main legal instrument of the European Union aimed at improving energy performance of buildings. The EPBD aims to improve energy efficiency of residential and non -residential buildings in the Union, taking into account external climate-related and local conditions, as well as considering indoor climate and cost-effectiveness requirements.

The EPBD was amended by Directive 2018/844, which came into force in July 2018. Directive 2018/844 introduced targeted changes to the EPBD, in order to:

- accelerate cost-effective renovation of existing buildings, with a vision of decarbonizing the building stock by 2050
- increase investment in building renovation
- introduce new provisions aimed at strengthening smart building technologies and technical systems, including the establishment of a new instrument for assessing the readiness of smart buildings - the intelligent readiness indicator, using artificial intelligence and/or blockchain wherever possible
- support the deployment of electromobility infrastructure in parking lots near buildings.

The amended EPBD was supported by the subsequent publication of two Commission documents:

- Recommendation on the renovation of buildings (EU/2019/786) • Recommendation on the modernization of buildings (EU/2019/1019).
- These recommendations contain further general information, best practice examples and supplementary information on the transposition of the amended EPBD provisions.

Context: European Green Deal and Renovation Wave

The European Green Deal is a growth strategy aimed at transforming the EU into a fair and prosperous society with a modern, resource-efficient, and competitive economy, as well as at achieving the overarching goal of making Europe climate neutral by 2050. It includes

a number of political initiatives aimed at addressing specific challenges, and one of them - the "Renovation Wave" - focuses on building renovation. The Renovation Wave takes the form of a strategic communication that uses an integrated approach encompassing all policy areas. Its goal will be to develop an action plan containing specific measures to remove major barriers and strengthen factors that encourage faster and deeper renovation, gradually leading to at least doubling current renovation rates and reducing the carbon footprint. As part of this initiative, one of the goals is to support smart building technologies, digital aspects and data, promote and strengthen the use of digital tools to increase the sustainability and adaptive capacity of buildings, and ensure optimal operation and maintenance of buildings and their systems. As announced in the Renovation Wave communication, the Commission has planned a targeted review of the EPBD directive in the fourth quarter of 2021. This review process may include elements relevant to the integration of renewable energy sources in buildings and the integration of buildings into energy communities. The implementer must take into account this review process and how it may affect the development of both energy renovations and energy communities, especially in terms of their integration at the development stage.

Context: Renewable Energy Directive

The Renewable Energy Directive provides a legal framework for the development of renewable energy in all sectors of the EU economy. It establishes common rules and regulations to remove barriers, stimulate investments, and lower the costs of renewable energy technologies, as well as enable citizens, consumers, and businesses to participate in the transition to clean energy.

In July 2021, the Commission proposed a revision of the directive as part of a package aimed at introducing the European Green Deal. This proposal increases the ambition of the existing legislation to align it with the stricter climate goals of the EU. It also aims to introduce new complementary measures to the existing foundations established in the directives of 2009 and 2018 to ensure the optimal use of all the potential of renewable energy, which is a necessary condition to achieve the EU's goal of climate neutrality by 2050.

The proposed revision aims to ensure that renewable energy fully contributes to achieving higher EU climate ambitions by 2030, in line with the 2030 climate target plan. It aims to transpose, into EU law, some of the concepts presented in the energy system integration strategies and hydrogen strategies published in 2020. Both strategies outlined ways to create conditions to achieve ambitious EU climate goals by 2030. They presented ways to create an integrated energy system based on renewable energy and capable of achieving climate neutrality, as well as transforming hydrogen into a real solution that will help achieve the goals of the European Green Deal.

According to EU climate law, the objectives and measures set out in the revised directive should be sufficiently ambitious to reduce greenhouse gas emissions by at least 55% by 2030. This includes increasing the overall renewable energy target (an increase to 40% is proposed), as well as stricter measures in transport, heating, and cooling sectors. The Commission also aims to create a more energy-efficient and circular energy system that will facilitate electrification based on renewable energy sources and stives to promote the use of renewable and low-emission fuels, including hydrogen, in sectors where electrification is not yet possible, such as the transport industry.

Magdalena Czałczyńska-Podolska
PhD, Eng. of Architecture, ZUT Professor
Department of Contemporary Architecture,
Design Theory and Methodology,
West Pomeranian University of Technology in Szczecin

ROLE OF GARDENS IN THE LANDSCAPING OF HOSPITAL PREMISES

BASICS OF DESIGNING HOSPITAL GARDENS AND THE IMPACT OF NATURE ON HUMANS

For hundreds of years, nature has been known to exert a positive effect on the lives of humans. Gardens and horticulture have also been known for their therapeutic and regenerative effect on humans and their communities. In ancient times, people were looking for beneficial health and well-being outcomes at locations offering unique natural and scenic qualities. Those seeking a cure for a specific disease used to visit sacred springs, streams, or groves where they were looking for healing plant species. Medieval monastery gardens often played the role of contemporary pharmacies and the first hospitals created in Western Europe were established on monastery grounds. During the Renaissance era, taking a walk in a garden was considered a remedy for numerous illnesses and was recommended by medics of the time as a cure for various ailments. In the Romantic period, when praising nature was fashionable, medical sciences were developing quickly and hygiene awareness was increasing. That is when first hospitals appeared with gardens forming an integral part of the landscape. In the eighteenth century, many European cities, including Paris, Marseilles, Florence, Pisa, and Vienna boasted hospitals whose patients were able not only to enjoy a walk in an on-site garden, but could also admire well maintained green areas by looking out of large windows installed in their individual rooms. In the mid-nineteenth century, trips to increasingly popular spa centers with large parks became common among those seeking healing and rejuvenation. Unfortunately, the developing functionalism of the early twentieth century and war devastation contributed to a shift away from a holistic approach in medical hospitality and the treatment of gardens as an integral part of healing in the hospital environment (Marcus, Barnes 1995). At this point in history, hospital gardens began to lose their therapeutic function. Instead, they started to become purely utilitarian and decorative elements having the form of isolated green areas or were simply replaced by parking lots. At the end of the twentieth century, the attitude towards gardens changed, as they once again began to be considered an important part of hospital premises. Such a change was caused by several factors, one of them being the development of new scientific disciplines, such as environmental psychology. Scientific research confirming the beneficial effects of nature on humans had a contributing effect as well. This change in attitude was also caused by the increasing interest in alternative methods of treating human ailments. Today, gardens are once again becoming an important part of hospital environments and are considered suitable for active and passive therapy sessions.

The current state of knowledge about the benefits of gardens unquestionably indicates that the conscious use of gardens in hospital development is justified and needed. Contact with nature, even if just of passive nature, helps reduce stress, relaxes, and evokes positive emotions. Groundbreaking research in this area was conducted by Roger Ulrich. Ulrich proved that being able admire green areas through a window speeds up the recovery process and reduces the need to take painkillers (Ulrich 1984). Furthermore, even the presence of pictures depicting nature in a hospital room improves the well-being of the patients (Ulrich 1993). Some therapeutic effects of horticultural therapy are as follows: an improvement of one's overall physical condition; increased muscle strength and mass, bone mass; better motor coordination; reduction of stress, tension, and aggression levels. Studies have shown the positive effects of gardening therapy on breast cancer patients. These patients are less prone to suffer from depression and fatigue, and are more willing to take on new challenges (Cimprich, Ronis 2003). The mood of cardiac patients who were subjected to horticultural therapy improved, and their stress levels were reduced (Wichrowski 2005). Participation of depressed patients in

horticultural therapy resulted in their detachment from problems, simultaneously boosting their interest in and fascination with the natural environment (Gonzalez 2010). Human contact with gardens also promotes healthy social interactions and reduces the risk of domestic violence (Sullivan and Kuo 1996). Scientific interest in the impact of nature on humans, along with a number of studies confirming the possibility of its therapeutic applications, has contributed to the creation of the interdisciplinary field of sociohorticulture (horticulture and its relations with humans). One of the tools of sociohorticulture is horticultural therapy which uses gardening to support traditional therapy and rehabilitation programs (Davis 1998).

THE BASIS FOR DESIGNING HOSPITAL GARDENS

Unfortunately, knowledge about the beneficial effects of nature on humans and the therapeutic potential of gardens is not widely recognized. Polish hospitals generally fail to take advantage of the potential that a properly landscaped building environment can offer. Generally, the condition of the land and the way it is developed only reflects minimal therapeutic and recreational functions, with no such connection existing in some cases altogether. Many hospitals, despite having favorable locations and conditions, have failed to design any gardens on their premises. The same may be said of those with suitable land reserves and remains of former gardens. The green areas existing next to some hospitals are often neglected and in a poor condition, meaning they cannot be considered actual and planned gardens. Places capable of providing various forms of therapy and promoting recovery are non-existent in the majority of contemporary hospital environments. The addition of a garden may complement a hospital's functional and programmatic offering, providing a place in which doctors and other staff members may rest, and serving as locations allowing patients and their visitors to relax and contemplate nature.

Properly landscaped, human-friendly spaces existing on hospital premises shorten treatment times, improve the effectiveness of therapy and minimize the levels of stress associated with treatment and hospital stays. Therefore, a therapeutic garden — a space designed primarily to improve people's well-being — should be an integral part of the development of any hospital (Eckerling 1996). Sensory gardens are a unique variety of therapeutic gardens. They are designed to intensively stimulate all human senses (sight, smell, hearing, taste, touch, and emotional feelings). Therapeutic gardens can and should be located at hospitals, sanatoriums, senior homes, hospices, and other types of therapeutic rehabilitation centers., Again, these gardens have proven not only to support the treatment of patients, but also to positively impact social integration processes, thus counteracting the phenomenon of social exclusion in hospital environments.

However, in order to effectively utilize the potential of a garden as a therapeutic space, it is not enough to simply stick some plants in the ground. Specific processes related to designing and shaping the area must be taken into account, with the needs of different groups of garden users, including patients of all ages, hospital employees and visitors, considered as well (Czałczyńska-Podolska, Rzeszotarska-Pałka 2016). If the patients are children, gardens must distract them from the dire reality of the hospital setting, and must be safe. A children's garden that is full of plants of various colors and textures will stir stimulate their senses by creating an atmosphere of mystery and enchantment. For adult patients, an alternative approach may be necessary. Gardens designed for adults should offer quiet and calm locations providing the feeling of privacy to promote integration and social contact. Places that stimulate participation in therapeutic activities should be available as well. Visitors appreciate intimate solutions, or garden interiors that foster a sense of privacy. As for the doctors, nurses, and other hospital staff, a garden should offer them a place to take their meal breaks and to seek out a spot of quiet repose. Because there are many human needs a garden can meet, it is advantageous to locate cafeterias in the garden and to create resting places with tables and comfortable seating (Czałczyńska-Podolska, Rzeszotarska-Pałka 2016). Furthermore, a therapeutic garden should be designed to stimulate users in different ways and to provide different use opportunities. This means that garden views should be available to patients who have to stay indoors. Transition zones connecting the garden and the building, such as terraces, patios, and small courtyards, are also important because they allow people to stay outdoors, simultaneously remaining within a safe distance from the hospital's facilities.

The specific nature of individual diseases and the plausibility and limitations of horticultural therapy are other important considerations to be taken into account while designing hospital gardens. Taking into account the specific needs of patients, we can advocate for the creation of specific designs of therapeutic gardens that are suitable for different types of users, including children, seniors,

Alzheimer patients, cancer patients, the visually and the hearing impaired, the mentally ill or the disabled. Alzheimer patients, for example, need a simplified layout of paths. The layout should be based on a loop returning to the point of departure, and the paths should not end with a cul-de-sack. It is a good idea to place small street furniture items or spatial forms in the garden, serving as landmarks.

It should be emphasized that simply making the space accessible, accommodating the needs of people with disabilities, or having contact with plants is not enough. A good understanding of the specific nature of a given disease or condition serves as a basis for designing suitable gardens and is essential to ensuring the proper management and selection of appropriate landscaping forms. Popular features used in therapeutic gardens include: water bodies (fountains, ponds), sensory paths, occupational therapy areas, garden tables, raised flower beds, areas with exercise equipment, as well as shaded and sheltered rest areas. Plants used in horticultural therapy should be carefully selected to avoid poisonous, prickly, or scorching species. However, species offering good sensory qualities, including those used in aromatherapy, are beneficial.

SUMMARY

Addressing the needs of different groups of garden users while taking into account the peculiarities of specific diseases and medical conditions may be a real challenge. While there is a distinct lack of consciously designed gardens with a therapeutic function in Poland, hospital gardens with examples of therapeutic spaces are not rare. In many countries, they are a standard solution and constitute an integral part of hospital premises - offering benefits to patients and other users, while simultaneously increasing their comfort and boosting the efficiency of treatments. Moreover, their implementation always proves that a holistic and empathetic approach has been adopted to treating patients and that an effort has been taken towards creating a human-friendly space. Gardens should be a highly desirable or an even indispensable element of hospital premises, as they drive the efficiency of medical procedures. In order for these positive changes to materialize, the outcomes of interdisciplinary research focusing on sociohorticulture must be relied upon to define applicable design guidelines which, in turn, must take into consideration the context and the needs of different patient groups and the potential therapeutic impact on specific diseases, conditions or symptoms.

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dr hab. Katarzyna Leśkiewicz
Prof. UAM, University of Adam Mickiewicz in Poznań, Faculty of Law and Administration, Department of Agricultural Food Law and Environmental Protection, partner in the group of TL HUB in Poznań, legal adviser

FOOD SECURITY AND FOOD SAFETY IN HOSPITAL NUTRITION

1. INTRODUCTION

'Hospital nutrition' is not an expression used in legal language. Although the Polish Act on Food and Nutrition Safety[1] contains the term 'nutrition' in its title, the concept is not actually defined in this particular act. The term refers to the nutrition that must be offered as part of the healthcare services provided by medical establishments on a 24-hour and stationary basis. Nutrition is provided under contracts concluded between the National Health Fund and specific healthcare providers.[2] To be precise, a healthcare service is a preventative measure or an activity that serves to preserve, save, restore or improve human health, as well as any other medical activity resulting from the treatment process or separate regulations regulating their provision. Food served in hospitals, in turn, is classified as 'auxiliary services'. One of the requirements is to offer 'food adequate to the state of health'.[3]

The concept of food security has now been recognized as a common challenge for the future. Several issues need to be taken into consideration here, including food sovereignty, access to land (right to land), etc[4]. All this makes this specific notion a multifaceted category that is studied in different fields of science and from a variety of perspectives (economic, legal, etc). Food security has evolved from a doctrinal category into an expression of legal language,[5] and has been used in soft law[6] documents, such as the Green Deal[7] and the Farm to Table Strategy.[8]

In contrast, the concept of food safety refers directly to food products and is one of the most important categories of food law.[9] According to the Polish Food and Nutrition Safety Act, food safety is a comprehensive set of conditions that must be met in the provision of food, in particular with regard to the additives and flavorings used, the levels of contaminants, pesticide residues, food irradiation, organoleptic properties, and the actions that must be taken at all stages of the production or marketing process to protect and foster human health and life. Food safety is therefore determined by a range of factors associated with product characteristics, as well as official food control activities, agricultural practices, and the activities of consumers themselves.[10]

1 Prof. UAM Dr. hab. Katarzyna Leśkiewicz, University of Adam Mickiewicz in Poznań, Faculty of Law and Administration, Department of Agricultural, Food and Environmental Protection Law, kles@amu.edu.pl; partner in the TL HUB group of companies in Poznań, legal adviser.
2 The Act on Food and Nutrition Safety of August 26, 2006, Journal Laws of 2020, item 2021, hereinafter also referred to as the Food and Nutrition Safety Act.
3 Cf. the Act on Health Care Services Financed from Public Funds of August 27, 2004, Journal Laws of 2021, item 1285; Act on Medical Activity of April 15, 2011, Journal of Laws of 2022, item 633.
4 Cf. Article 5(37)(38) and (40) of the Act on Health Care Services Financed from Public Funds.
5 Cf. K. Leśkiewicz, Prawo żywnościowe, Warszawa 2020, p. 2-9 and the literature cited therein.
6 See the preamble to the Act on the Shaping of the Agricultural System of April 11, 2003, Journal of Laws of 2022, item 461.
7 Resolution adopted by the General Assembly on September 25, 2015 [without reference to the Main Committee (A/70/L.1)] 70/1. Transforming our world: the 2030 Agenda for Sustainable Development, http://www.unic.un.org.pl/les/164/Agenda%202030_pl_2016_ostateczna. pdf [accessed: June 15, 2022].
8 European Parliament resolution of 15 January 2020 on the European Green Deal (2019/2956(RSP)), hereinafter also referred to as the European Green Deal.
9 P Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A Farm to Fork Strategy for a Fair, Healthy and Environment-friendly Food System, Brussels, 20.5.2020 COM(2020) 381 final, hereinafter referred to as the Farm to Fork Strategy.
10 See the Food and Nutrition Safety Act of August 25, 2006, Journal of Laws of 2020, item 2021; Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety, Official Journal EC L 31, 01.02.2002, p. 1; Official Journal EU, special Polish edition, chapter 15, vol. 6, p. 463, hereinafter referred to as Regulation No. 178/2002.

The subject matter referred to in the title has not been addressed in the scholarly legal literature; studies have only addressed the general topic of food safety and food security.[11] There are, however, numerous publications by representatives of nutritional sciences[12] and institutions dealing with the application of food law.[13]

The need to implement the objectives of the European Green Deal and the 2030 Agenda is a particularly strong reason for addressing the issue touched upon in the title. Reducing greenhouse gas emissions and protecting natural resources, including biodiversity, requires the involvement of all sectors of the economy. The fight against climate change is therefore also linked to proper nutrition that is considered to be a part of public health protection. However, in Poland, hospital nutrition has not always met the basic requirements of food safety and hygiene: in 2018 the Supreme Audit Office reported that patients in the majority of the audited hospitals were not fed in a manner that would be adequate to the condition of their health.[14]

With the above borne in mind, the aim of this paper is to assess whether the current regulations concerning hospital nutrition take into account the postulates of the European Green Deal and the Farm to Table Strategy.

2. STATUS AND OBLIGATIONS OF HOSPITALS IN LIGHT OF FOOD LAW REGULATIONS

Pursuant to Article 2(1)(9) of the Act on Healthcare Institutions, a hospital is a medical establishment in which a medical entity performs medical activities as hospital services, excluding guaranteed services provided by hospitals to beneficiaries with the intention of completing them within a period of not more than 24 hours. In the light of the provisions of the Food and Nutrition Safety Act (Article 3(3)(56)), hospitals are categorised as mass catering establishments of the closed type. A mass catering establishment is a mass caterer within the meaning of Article 2(2)(d) of Regulation No 1169/2011[15]. In the case of hospitals, it is the patient who is the end consumer. A mass caterer of the closed type is understood to be a facility engaged in feeding, in an organized manner, specific groups of consumers. Such facilities include hospitals, care and educational establishments, crèches, kindergartens, schools, boarding schools, and workplaces, with the exception of feeding on board of aircraft or other means of transport, as well as military field feeding stations. A hospital has the status of a 'food business operator', meaning a natural or legal person responsible for meeting the requirements provided for in the food law while conducting food-related business activity under its control. This concept encompasses the responsibility of persons (entities) in positions of responsibility, including hospital directors, who are obliged to meet a number of food safety and hygiene-related requirements while rendering hospital nutrition services. Due to the limited scope of this study, these requirements can only be outlined briefly.

3. KEY ELEMENTS OF HOSPITAL NUTRITION

In its Article 72(6), the Food and Nutrition Safety Act stipulates that the minister responsible for health-related matters may optionally specify, by means of a regulation, 'the requirements applicable to offering mass-scale, closed-type catering services, taking into consideration applicable nutrition standards and health requirements'. According to the draft regulation of the Minister of Health on defining the requirements applicable to the provision of catering services in hospitals, these requirements cover the following: the codes and nomenclatures used for describing hospital diets, as laid down in Annex No. 1 to the regulation; the types of diets and their characteristics, the recommended and contraindicated foodstuffs used in the various types of diets, as well as the nutritional and energy value of hospital diets, as set out in Annex No. 2 to the regulation; and a template of a hospital nutrition card, as specified in Annex No. 3 to the regulation. Furthermore, §2 of this draft states that the requirements referred to above 'shall take into account current knowledge and nutrition standards

11 Cf. Legal Protection of Human Health Against the Unsafe Agricultural Food (ed. K. Leśkiewicz), Warszawa 2022.
12 Cf. K. Leśkiewicz, Bezpieczeństwo żywnościowe i bezpieczeństwo żywności – aspekty prawne, „Przegląd Prawa Rolnego" 2012, no. 1(10), p. 179–197; Cf. Legal Protection of Human Health Against the Unsafe Agricultural Food (ed. K. Leśkiewicz), Warszawa 2022; Cf. e.g. T. King, M., Cole, J.M., Farber, G. Eisenbrand, D., Zabaras, E.M. Fox, J.P. Hill, Food safety for food security: Relationship between global megatrends and developments in food safety in: Trends in Food Science and Technology 2017, 68, p. 160-175..
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recommended for the population of the Republic of Poland'. Thus, over the years, nutrition services provided in hospitals have been based on applicable nutrition standards.[16] Unfortunately, contrary to the recommendations presented in the 2018 report by the Supreme Audit Office, no mandatory consultations concerning patient nutrition with a diet expert have been introduced. It is therefore evident that the food legislation currently in force focuses exclusively on the safety aspect of nutrition, doing so in a way that calls for improvement.

4. FOOD SECURITY

In the aforementioned regulation and draft provisions, there is no requirement to introduce solutions in hospital nutrition which would also foster food security and thus protect the climate. On the one hand, this can be explained by the nature of food law regulations which focus on product safety. On the other hand, matters associated with food security tend to be related to a specific policy (practice). At international level, the most important document emphasizing the importance of food security is the UN 2030 Agenda for Sustainable Development[17]. The more detailed aspects of food security concern food sovereignty, i.e. food self-sufficiency in terms of agricultural production and the related right to land[18] and water.[19] The concepts of food sustainability were created on the basis of the principle of sustainable development. Food sustainability entails building sustainable food systems.[20] This concept clearly emphasizes the protection of resources, human and animal health, and combating climate change.[21] Food and farming systems should be more social, ecological and economical. Food insecurity[22]or even famine and starvation[23] are the terms that are the opposite of food security.

From the point of view of hospitals and hospital nutrition, it would make sense to incorporate food security-related aspects into the healthcare program created pursuant to Article 48a of the Act on Health Care Services Financed from Public Funds. The drafters of this document include the Minister of Health and local government entities. The document is created based on a map of health-related needs and the epidemiological data that is available. This program must include, inter alia, the objectives of the health policy and measures which will allow the effectiveness of its implementation to be assessed. In addition to the need to treat diseases, an appropriate basis for the proper provision of hospital nutrition should also be formulated, starting with the obligatory recourse by hospitals to public procurement regulations that take into account high-quality of food (including regional, traditional and organic food), and food provided through short supply chains from local or domestic producer markets. The diet available and nutrition services provided in hospitals should not only meet the applicable food safety requirements and the best standards based on the research of representatives of nutritional sciences, but should also involve the careful and conscious selection of food products whose production minimizes the carbon footprint and does not pose a threat to natural resources or biodiversity. The selection of such products would be in line with the concept of food sustainability and would contribute to building sustainable food systems.[24] The UN institutions argue that 'sustainable food and agricultural systems cannot be achieved without significant additional efforts', which means that the efforts made thus far have been insufficient.[25]

16 Regulation (EU) No 1169/2011 of the European Parliament and of the Council of 25 October 2011 on the provision of food information to consumers, amending Regulations (EC) No 1924/2006 and (EC) No 1925/2006 and repealing Commission Directive 87/250/EEC, Council Directive 90/496/EEC, Commission Directive 1999/10/EC, Directive 2000/13/EC of the European Parliament and of the Council, Commission Directives 2002/67/EC and 2008/5/EC, and Commission Regulation (EC) No. 608/2004, Official Journal of the European Union L 304/18, hereinafter referred to as Regulation No. 1169/2011.
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18 General Assembly Resolution A/RES/70/1: Agenda for Sustainable Development 2030 http://www.unic.un.org.pl/files/164/Agenda%202030_pl_2016_ostateczna.pdf [accessed: 30.6.2020].
19 T. Srogosz, Międzynarodowe prawo, p. 62; cf. R. Pastuszko, Land grabbing. Podstawowe zagadnienia prawne, SIL 2017, vol. XXVI, 1, p. 147-156, DOI: 10.17951/sil.2017.26.1.147, [accessed 24.6.2020].
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5. CONCLUSIONS

Current regulations pertaining to hospital nutrition focus exclusively on food safety requirements. However, food security-related requirements should be specified in documents presenting programs, directions of action, and good practices. It is necessary to ensure sustainable public procurement of high-quality (e.g. organic, regional and traditional) food from local markets, preferably via short food supply chains. Above all, hospital diets should be based on products produced with the use of climate-friendly methods. One may state that the creation of appropriate hospital nutrition practices should be based on the provisions of the Constitution of the Republic of Poland1, according to which the Republic of Poland ensures the protection of the environment and is guided by the principle of sustainable development (Article 5). The Constitution stipulates also that the protection of the environment is the responsibility of the public authorities (Article 74(2)) and international law in its broadest sense (including EU treaties and other acts, such as the European Green Deal).

Independent Public Clinical Hospital No. 1
Pomeranian Medical University

Green energy for hospitals + energy efficiency

Located near Napoleon Hill, Teresa Hulboj Park and the old Arkoński Forest, the Independent Public Clinical Hospital No. 1 PUM in Szczecin has a specific microclimate that facilitates the healing process. SPSK 1 is a multi-pro_file hospital, and the mission of the hospital is "*To provide highly specialized medical care*". The hospital has 3 locations: in Szczecin, at Unii Lubelskiej 1 street, at Broniewskiego 26 street and in Police, at Siedlecka 2 street. The organizational structure of the Hospital includes the Emergency Department, 3 Departments and 26 clinics / wards, with a total number of 773 beds. The number of hospitalizations and patients treated at the Hospital's Emergency Department is approximately 117,843 per year. More than 16,000 patients are operated on each year and nearly 200,000 people are provided with a specialist's advice annually.

The hospital has been pursuing, for a number of years now, several projects aiming to adapt the facility to climate change. Thanks to those efforts it contributes, to a certain extent, to preventing health problems among local residents. Thanks to numerous grants from the National and Voivodeship Funds for Environmental Protection and Water Management (NFOŚIGW and WFOŚIGW, respectively), we were able to complete a number of pro-ecological investment projects. We started in 2002 by constructing and commissioning a new, fully automated gas- and oil-fired boiler facility. In 2005, a medical waste incineration plant was put into operation thanks, inter alia, to a grant from the Danish Environmental Protection Agency - DEPA. The project was, back then, the only in Poland that met the requirements of national laws and the EU Directive, as it allowed for continuous monitoring of the content of particulate matter and hazardous gases, as well as other parameters of the process of thermal decomposition of waste. In 2012, the thermal modernization of the hospital's buildings, which lasted almost 2 years, was completed. The building's facades were insulated, all windows and doors were replaced and central heating and domestic hot water systems were modernized. This has allowed to improve the energy efficiency of buildings by approx. 30%. The end result of the thermal modernization project is the achievement of the expected environmental effect, i.e. reduction of gas consumption, CO_2 emissions, heat losses, environmental fees paid, as well as heat savings and improvement of the patients' comfort.

2020 is the year in which the hospital intends to complete particularly important investments to improve the standard of patient care and protect the environment. The construction of a photovoltaic power plant with the accompanying infrastructure was one of such spectacular projects. The power plant consists of 2,116 photovoltaic panels and 23 inverters. The total power of the installed panels is 740.60 kWp, which makes it one of the largest roof installations in the country. The panels cover roofs and facades of the hospital buildings with a total area of 4,097.6 m². Within just 4 months following the installation of the panels, the algorithm of the Fusion Solar platform calculated that we were able to reduce CO_2 production by over 305 tons. In the long term, our installation significantly contributed to the reduction of CO_2 emissions, as well as decreased the amount of other greenhouse gases emitted into the atmosphere during the production of energy from conventional sources. The other project consisted in the completion of the last stage of the reconstruction and renovation of the main building of the Psychiatry Clinic, along with the installation of another photovoltaic power plant. This power plant consists of 2 microinstallations, 60 panels each, with a total capacity of 38.40 kWp. The following environmental effects have been achieved:

- reduction of CO_2 emissions by 409.18 tons/year
- reduction of heat energy demand - 2,919 GJ/year
- electricity savings of 101.96 kWh/year.

The energy from the two photovoltaic power plants is used, in full, to cover the current demand for electricity. During the 25-month period of operation, both power plants produced 1080.95 MWh of electricity (with its cost equaling PLN 668,830). The production of "green energy" has contributed to reducing, in 2020-2022, the emissions of harmful substances, by:

1. CO_2 455.7 tons (Mg)
2. SOx / SO_2 0.358 tons (Mg)
3. NOx / NO_2 0.361 tons (Mg)
4. CO 0.149 tons (Mg)
5. Total PM 0.019 tons (Mg)

This means that we saved 38,000 trees required to absorb this amount of pollution.

Our efforts aiming to obtain the status of an environmentally friendly hospital will be complete after completing a project entitled: "Thermal modernization of SPSK 1 PUM buildings in Police under the program 3.4.1 Energy-efficient construction; part 1 - Reducing energy consumption of buildings. Work in the hospital in Police is to be finished by the end of June 2023 and will be co-financed by the National Fund for Environmental Protection and Water Management (PLN 41.3 million in subsidies and over PLN 2.1 million in the form of a preferential loan). The total cost of the investment will be approximately PLN 43.5 million. The work will include thermal insulation of external walls, installation of new anti-moisture insulating materials, replacement of windows, doors, and central heating systems. The existing mechanical ventilation system will be reconstructed as well, as will be the heating network distributing heat from the local heat source, and the heat source itself. Thanks to this project, we will become fully independent of external heat sources.

In the meantime, in order to minimize the risk of environmental pollution and limit the use of resources, our water pumping station was modernized to comply with all applicable safety and efficiency requirements.

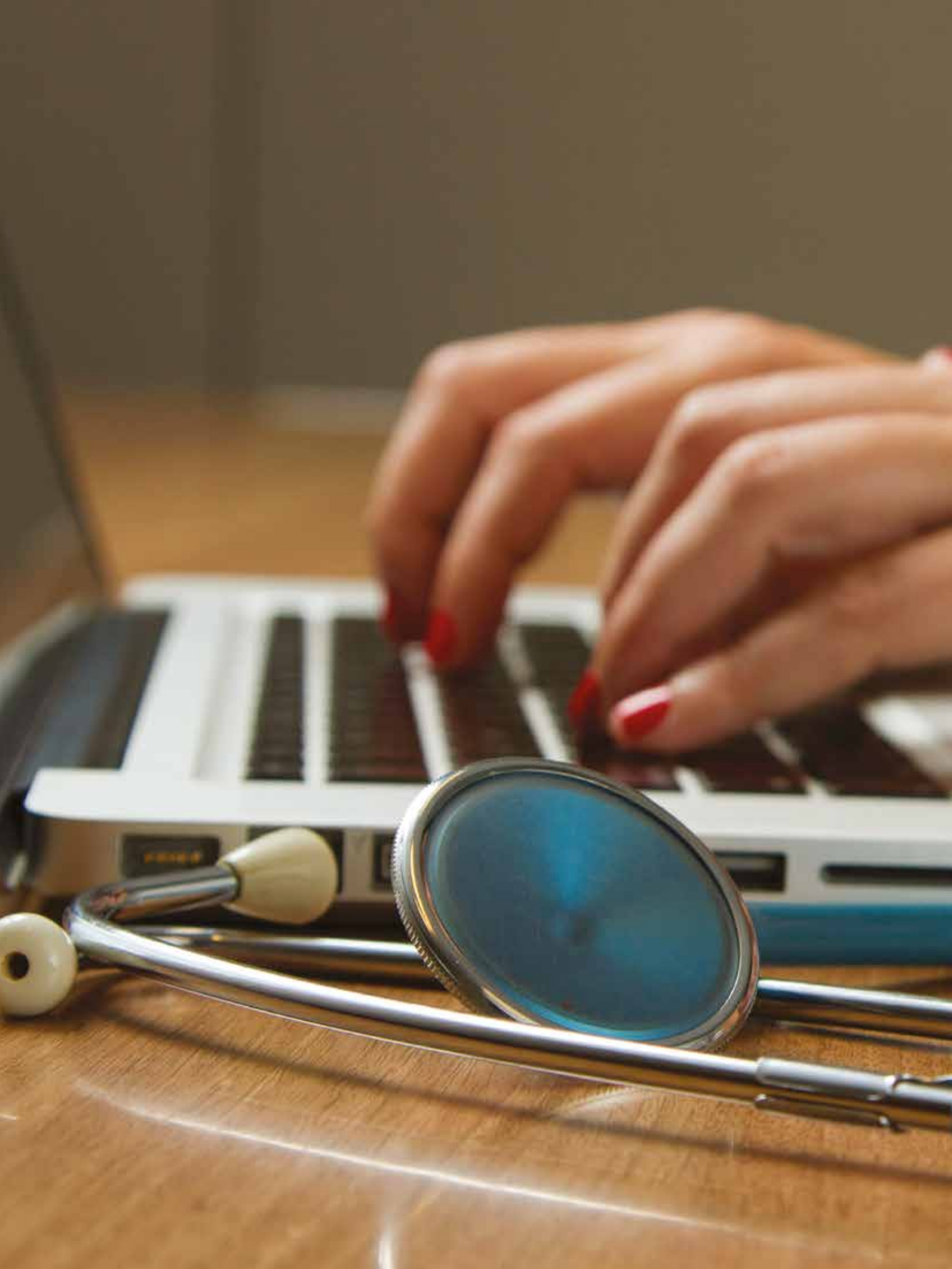
In addition to modernizing the existing and newly built infrastructure of the Hospital, we also strive to instill environmentally friendly attitudes in our employees. In last year, the majority of the hospital's clinics, and all specialistic clinics, switched to keeping electronic medical records, in line with our "paperless operations" policy. Electronic documentation also allows to achieve environmental benefits, as we no longer need to archive huge amounts of paper documents produced. The EDM system has one more benefit - medical staff may spend more time caring for patients.

This year we have also implemented a modern HR & payroll computer system supporting HR management and payroll functions. It also allows employees to submit electronic leave applications. Thanks to the program, it the processes may be handled in an efficient manner, applications may be submitted easily and instant communication is ensured. Above all, however, all staff-related services are rendered in accordance with the "paperless operations" policy as well.

For many years now, the hospital has been taking care of the correct segregation of medical waste and promotes educational activities to strengthen the environmental awareness of not only its employees, but also patients and visitors, which is of key importance for the implementation of applicable environmental standards. In 2021, as part of the "Environmentally friendly" campaign, we organized a competition for SPSK1 PUM clinics / wards entitled: "ECOleader - a good choice!" to promote ecological knowledge at supra-local scale. As part of the campaign, we provided participants (at 3 locations) with stations and bins for segregating municipal waste. We also installed educational boards for patients and visitors. It has been estimated that the campaign has reached at least 75,000 people, i.e., 30% of all those who set foot in the hospital (in 2019, the combined number of employees, patients and visitors equaled approx. 250,000). At present, together with the Provincial Fund for Environmental Protection and Water Management in Szczecin, we are conducting this campaign at all hospital wards and administrative units.

Striving to create a healthy future for people and the planet, our hospital is preparing - as part of its effort to reduce the emissions of harmful gases into the atmosphere - to purchase an electric car, an electric ambulance for transporting patients and intends to construct a charging station for these vehicles. The charging station will be also capable of charging electric bicycles and scooters used by employees and people visiting the hospital and choosing this environmentally friendly method of transport.

We are convinced that all the activities we have planned will translate not only into lowering our operating costs, but also into measurable benefits for the environment.



II.
The voice of business

accenture

ACCENTURE

The role of technology in sustainable development of healthcare organizations

Health & Life Sciences Lead for Strategy & Consulting for Poland'

Technology may contribute to improving the accessibility and quality of healthcare, thus facilitating the achievement of one of the sustainable development goals: "Ensure a healthy life for all people of all ages and promote well-being"[1].

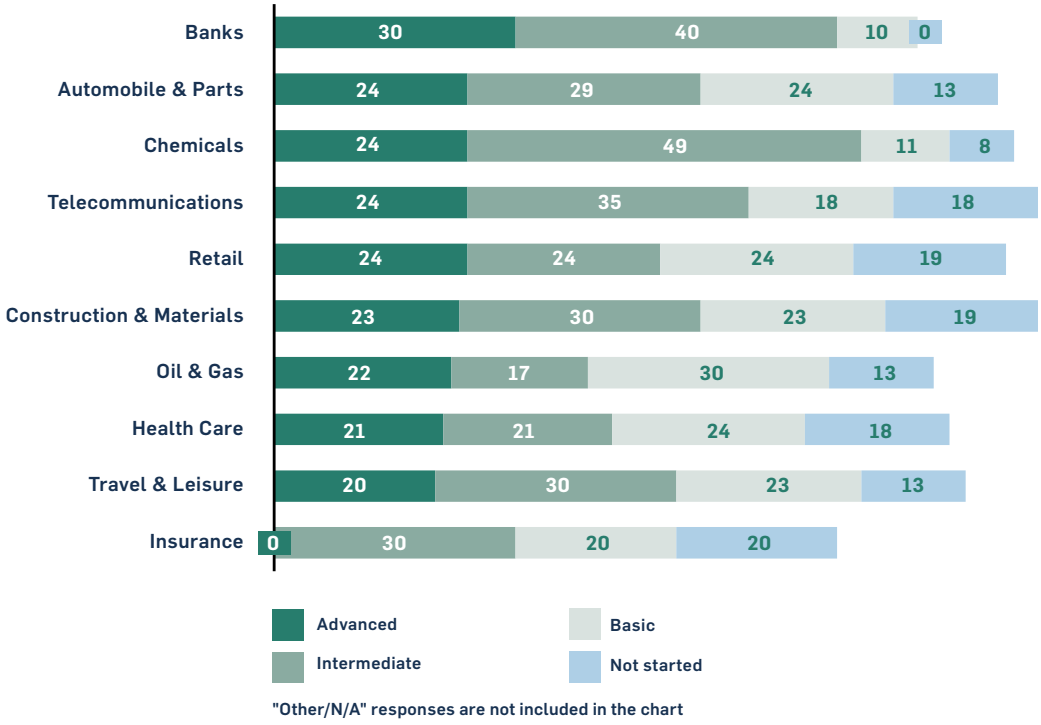
As the healthcare system moves towards a greater degree of patient-centricity, healthcare organizations can improve access to care by transforming and improving patient involvement in the treatment process. Properly designed processes allow to better adjust the service offering to current health-related needs and to patient preferences by adopting a holistic and sustainable approach. The existing patient support instruments (such as, for instance, price discounts) are not sufficient to ensure equal access to care. Technology is capable of changing that.

Barriers hindering access to healthcare are often based on social and demographic circumstances, e.g. the distance that needs to be covered to reach a healthcare facility, lack of availability of means of transport, or low health literacy levels. Healthcare providers may help patients achieve better outcomes in the treatment process if they take into account the applicable social determinants and, by relying on technology, eliminate barriers preventing access to services and promote patient education. The initiatives taken in Nordic countries, i.e., in Finland or Norway, may serve as a good example here, where information about the applicable social determinants is included in the electronic medical records, thus allowing patient pathways (*workflows*) to be adjusted accordingly[2].

Additionally, climate change is accelerating the transition to more sustainable business models adopted by CEOs across industries and regions. Organizations operating in the healthcare market are unlikely to be pioneers in discussing the maturity of the implementation of sustainable development policies[3].

1 https://www.un.org.pl/cel3
2 https://www.accenture.com/_acnmedia/PDF-134/Accenture-812870-Social-Determinants-Assets-Nordic-file-v4.pdf
3 https://www.accenture.com/_acnmedia/PDF-166/Accenture-UNGC-CEO-Study-Sustainability-2021.pdf

Diagram 1.
How mature is your company in deploying new and circular business models? (% of respondents from each industry)



Source: Accenture and UNGC Sustainability Study 2021, https://www.accenture.com/_acnmediaPDF-166/Accenture-UNGC-CEO-Study-Sustainability-2021.pdf
"Other" indicates respondents who provided "do not know" or "not applicable" answers. The percentages may not add up to 100% due to rounding

Healthcare managers claim they are aware of the challenges their organizations face when implementing sustainable development models.

- 67% agree that becoming a truly sustainable and responsible business is a top priority for their organization for the next 3 years;
- 63% agree they have developed a robust plan to embed stakeholder (patients and employees) perspectives into day-to-day decision-making;
- 62% agree the pandemic has highlighted the need to transition to more sustainable business models[4].

To become a truly sustainable organization, it is necessary to transform both the business and operating models. **The primary requirement, however, is to build a stakeholder-oriented organization.**

Managers of healthcare organizations are committed to transforming the value of responsible leadership into a sustainable behavioral change that will bring about positive results.

- An Accenture study found that 68% of senior executives believe they create empowering workplace environments – but only 36% of employees agree with that statement[5].
- 64% of employees working for healthcare organizations expect their employer to make them "net better off" through work[6].
- The attention that organizations pay to their stakeholders is often "wound up" rather than fully embedded in their culture and policies.

This means that healthcare organizations acting in the capacity of employers are required to offer not only adequate financial conditions for their staff, but also suitable infrastructures, career development paths, a sense of belonging and emotional support.

4 https://www.accenture.com/_acnmedia/Thought-Leadership-Assets/PDF-5/Accenture-Sustainable-Organization-Gap-Report.pdf; Health sample: N=100 executives, N=109 health organization employees
5 https://www.accenture.com/gb-en/about/inclusion-diversity/culture-equality-research
6 https://www.accenture.com/_acnmedia/PDF-156/Accenture-Health-Caring-Employees-Business.pdf#zoom=40

WHAT CHANGE LOOKS LIKE

Where sustainability is "bolted on" as opposed to "built in", leadership teams face three key challenges. Each of them may be addressed by embedding the sustainability approach:

FROM	TO
Patchy, one-way stakeholder relationships	**Human connections:** strong, symbiotic stakeholder relationships and an understanding of stakeholder needs
Shallow insight into stakeholder perspectives	**Collective intelligence:** decision-making mechanisms that turn insights about stakeholder needs into action
Lack of shared ownership for operating sustainability	**Accountability at all levels:** stakeholder value creation becomes an expectation across the entire organization

Change may definitely be facilitated by technology, but it should also be an outcome of sustainable development. Current **sustainable technology** initiatives are missing a few critical ingredients. For example, there is a distinct lack of design standards and specifications. A shortage of people trained in developing sustainable software is experienced as well. Accenture and Microsoft — along with GitHub and ThoughtWorks — are the founding members of the Green Software Foundation (GSF)[7]. This initiative aims to build an ecosystem of people, standards, tooling, and practices to reduce carbon emissions generated by software development-related activities. It is the first industry consortium of this nature, born out of a desire to meet the ICT sector's goal of achieving a **45% reduction in greenhouse gas emissions by 2030**[8].

Most organizations are currently constrained by the lack of tools and practices related to the implementation of sustainable technology. The World Economic Forum (WEF) has launched the Global AI Action Alliance, bringing together more than 100 companies, governments, civil society organizations, and academic institutions to accelerate the adoption of inclusive, transparent, and trusted AI[9].

Organizations operating on the healthcare market may achieve their ESG goals by taking action in the four areas described below:

1. **Provide stakeholders with emotional support**
2. **Secure stakeholders' data and build trust**
3. **Use technology to increase and facilitate access to healthcare**
4. **Implement solutions that ensure access to healthcare for all**

For more information about sustainable development, please go to:
Organizational Sustainability Transformation (accenture.com)
Healthcare Consulting Services & Solutions (accenture.com)

Katarzyna Byszek
Health Researcher

Marcin Howorko
Principal Director – Health & Life Sciences Lead for Strategy & Consulting

7 https://newsroom.accenture.com/news/accenture-github-microsoft-and-thoughtworks-launch-the-green-softwarefoundation-with-the-linux-foundation-to-put-sustainability-at-the-core-of-software-engineering.htm
8 https://www.accenture.com/_acnmedia/PDF-177/Accenture-Tech-Sustainability-uniting-Sustainability-and-Technology.pdf#zoom=40
9 https://www.weforum.org/press/2021/01/world-economic-forum-launches-new-global-initiative-to-advance-thepromise-of-responsible-artificial-intelligence/


HOSPITAL
FERNANDO GUARDI

Fala Renowacji

The importance of improving energy efficiency in the healthcare sector

Key elements

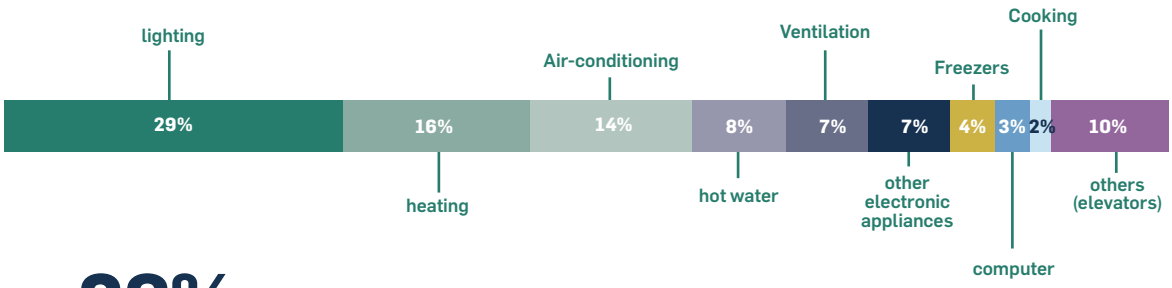
The cost of energy borne by healthcare facilities, especially by hospitals, has the largest share in their operating cost structure and accounts for approximately 30% of overall building maintenance spending, surpassing even the cost of cleaning (23%)[1]. Therefore, the operating profit of healthcare facilities depends directly on their energy consumption[2], almost half of all healthcare buildings in Poland have been renovated between 2004 and 2017, either partially or in a comprehensive manner. As the same report points out, the level of awareness that energy savings may be increased by taking such actions is increasing. The replacement of windows and external doors was the most popular approach in 2004-2013, but modernization of the heating system took over as the most frequent activity between 2014 and 2016. It is obvious that best results would be achieved if both of the aforementioned approaches were combined to complete a deep modernization in line with the Energy Efficiency First principle. This would reduce energy consumption and, subsequently its costs. Reducing demand for energy, especially in light of the radical increase in its price, is the fastest way to lowering hospitals' utility bills. A deep modernization involving the renovation of a variety of systems that are vital for performing the hospitals' role is key. However, the installment of systems powered by renewable energy sources (RES) is equally important. Nonetheless, prior to the installation of a heat pump or other RES solutions, the building should be insulated properly, in accordance with the results of a suitable energy audit. Additionally, if a PV system is to be installed on the roof, the safety of patients and staff should also be taken in to account by selecting a fireproof insulation material that would stop the spread of fire to the rest of the building in the event the failure of the solar system causes a fire.

The high share of energy costs in the overall operating expenditure of hospitals results from the specific function they perform. Above all, hospitals are required to be operational on a 24/7 basis, in order to provide continuous care for the sick, as an interruption in its provision may potentially have very dramatic consequences. The need to install backup generators additionally increases the operating costs. Hospital buildings require also effective air filtration systems to prevent the spread of diseases (the so-called hospital-borne infections) through the ventilation systems. This challenge may be addressed by installing suitable filters. These, however, increase the demand for electricity powering the fans that ensure adequate air circulation. Hospital laundry facilities and kitchens may be responsible for using up to 15% of the building's energy. Therefore, the need to monitor the periods with peak energy demand levels arises.

Ensuring suitable quality of air that should be strictly regulated in terms of temperature and humidity levels, especially in operating theaters, is another important element of managing hospital buildings. This increases energy demand even further, inflating the costs of operating heating, cooling and ventilation systems. The high temperature required in the hot water system to inactivate bacteria is another element that additionally increases the operating costs of buildings. Furthermore, some areas within the hospital require specific air conditioning settings, for instance in connection with the medicinal materials stored (e.g. cements used in orthopedics, which tend cure too fast in excessively high temperatures). Correct pressure parameters in HVAC systems installed in operating theaters or intensive care units need to be maintained as well. Overpressure is one of the ways of preventing the transmission of airborne diseases. On the other hand, quarantine rooms require negative pressure and UV lamps to prevent and control the spread of infectious diseases[3]. All these factors make a hospital building costly to maintain. However, savings opportunities offered by state-of-the-art energy management systems and insulation solutions are greater than those available in any other types of buildings.

1 Energy costs survey by Danfoss
2 EPA, US Environmental Protection Agency, for commercial buildings
3 T.A.C., Leading Techniques for Energy Savings in Healthcare Facilities, WP-HEALTHCAREENERGY-US 06/06 v1, p. 6.

Graph 1.
Energy consumption structure



38%
How much energy is "consumed" by heating, air conditioning and hot water systems

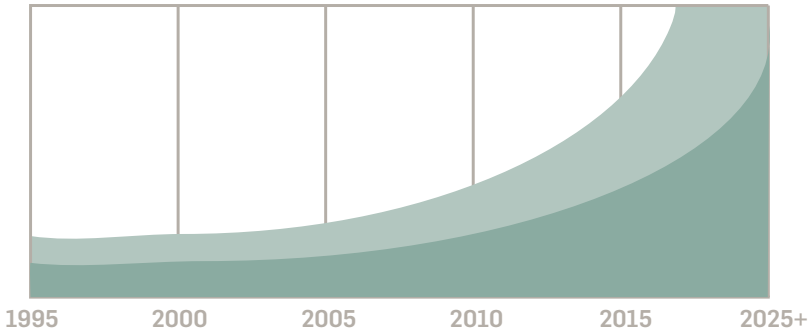
Source: University of Michigan, US Center of Sustainable Systems (provided by Danfoss)

As shown the diagram above, heating, air conditioning and hot water systems "consume" approx. 38% of all energy used. However, energy efficiency of hospital buildings impacts not only their maintenance costs. It is also related to the technical requirements they need to fulfil and translates into the conditions inside the building, thus affecting performance, comfort and health of both staff and patients. Excessively high or low temperatures in the rooms, especially when combined with low humidity levels, are not conducive to good health either. At temperatures exceeding 21°C, the mucous membrane present in the respiratory tract tends to dry up, weakening the natural mechanisms relied upon for removing viruses and bacteria from the nose and the throat. This increases the frequency of colds, headaches, low blood pressure, fatigue and weakness. If the periods we spend indoors, in excessively high temperatures, are prolonged, dehydration may kick in, triggering heart problems.

The provision of conditions that are optimal for the treatment of patients becomes ever more expensive.

The research of Schneider Electric proves that we can only expect a further increase in energy costs.

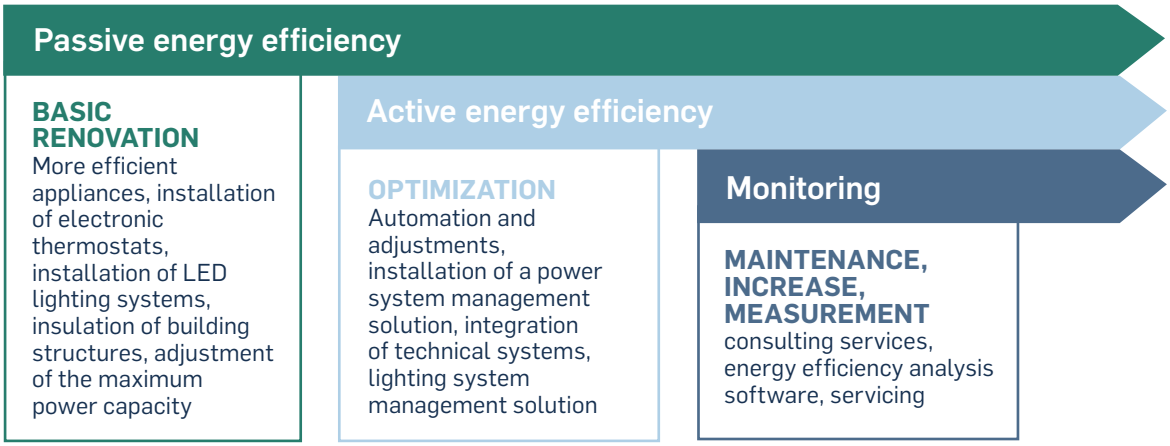
Graph 2.
Projected increase in energy consumption and energy costs in the healthcare system, since 1995



Source: Schneider Electric Industries SAS: How to improve your hospital's financial health, 2011, p. 2

Due to the specific regimes hospital buildings are subject to, as well as due to the above-mentioned factors increasing energy costs, and trends clearly showing the likely future increase in these costs, hospitals are considered to be a peculiar type of buildings that require a special approach to energy efficiency. This parameter not only affects energy consumption, but also offers ample room in terms of improving the comfort of hospital stays.

Graph 3.
The sequence of actions leading to the improvement of energy efficiency and sustainable cost reduction



Source: own study

The amount of energy that may be saved in hospital buildings depends on a number of factors. The buildings may be subjected to in-depth renovation projects, but their technical systems and specific installations may be improved as well. Such an approach, starting with focusing on the passive use of energy by the individual systems, and ending with actively managing the building's energy use, will help balance hospital budgets, simultaneously ensuring a greater degree of control over its operating costs. Because of the wide variety of systems installed in hospital buildings, these need to be not only modernized, but also integrated (e.g. HVAC systems). While control and management technologies intended for these systems are of fundamental importance, a particular emphasis must be placed on monitoring their operation and on the implementation of additional improvements in accordance with outcomes of energy efficiency audits.

Justyna Glusman
Stowarzyszenie Fala Renowacji

GIDE
GIDE LOYRETTE NOUEL

Gide Loyrette Nouel

Infectious medical waste – the legal framework and challenges for polish hospitals in the face of clashing epidemiological safety reqiurements and demands for a green, zero-carbon

The COVID-19 pandemic and the associated number of hospitalisations of patients infected with the rapidly spreading virus resulted in an unprecedented increase in the volume of medical waste (particularly of the infectious variety) generated by Polish hospitals. The crisis situation revealed a number of weaknesses in the manner this exceptionally demanding type of waste is managed in Poland and provoked a wide-ranging, cross-industry discussion on necessary systemic changes. It is worth taking a look at the current regulations in order to identify the sources of the problems and explore potential ways of solving them.

Medical, infectious - what does that mean?

Under Article 3(1)(8) of the Waste Act[1], medical waste is understood as waste generated in connection with the provision of healthcare services and the conduct of medical research and experiments. This relatively broad and general legal definition is intended to distinguish such waste from municipal waste, which is also generated in large quantities by healthcare facilities.

The issue of categorizing waste as infectious is slightly more complex and is governed by a separate implementing regulation[2] setting out the limits for the presence of microbiological contaminants and toxins. If these limits are exceeded, waste is considered to have infectious properties. This method of classification also allows municipal waste (such as water bottles or disposable cutlery) to be classified as infectious if the items disposed of were used by a patient with an infectious disease, whereas under normal circumstances they would not even constitute “regular” medical waste. During a pandemic, this must have inevitably led to an exponential increase in the amount of infectious waste generated, with it being subject to strict management rules.

Close & fast

The main consequence of the status of infectious waste is that it must be disposed of at hazardous waste incineration plants and cannot be incinerated along with other types of waste (Article 95(2) and (3) of the Waste Act). While alternative methods for treating certain categories of standard medical waste exist, including physicochemical treatment (“D9 process”) and even landfilling (“D5 process”) and are permitted under the sectoral regulation[3], infectious waste must undergo thermal treatment (“D10 process”) at a minimum temperature of 1100 °C.

In practice, the requirements concerning the manner in which infectious waste is disposed of are not the greatest challenge for hospitals. Strict collection- and transport -related rules seem to be more troublesome. Article 20(3) et seq. of the Waste Act introduces the "proximity principle" whereby, subject to specific exceptions, infectious medical waste must not be exported and processed outside of the voivodeship in which it has been generated. Another source of problems is the ban to collect infectious medical waste outside of the premises at which it has been generated (Article 23(2)(3) of the Waste Act) which, combined with the ban on storing such waste at landfills (Article 122(1)(3) of the said act), means that the generating entity is obliged to store infectious waste on its premises, until it is handed over to an entity authorised to collect it and transport it to an incineration plant. Logistics are further complicated by the fact that, according to § 8 of the regulation governing the procedure for handling medical waste[4], most infectious waste can be stored in a healthcare facility for no longer than

1 Act on Waste of 14 December 2012 (Journal of Laws of 2022, item 699, as amended).
2 Ordinance of the Minister of Climate of 24 December 2019 on the conditions for recognising waste as having infectious properties and the manner of determining such properties (Journal of Laws of 2020, item 3).
3 Ordinance of the Minister of Climate and Environment of 26 November 2021 on the disposal and storage of medical waste and veterinary waste (Journal of Laws of 2021, item 2245).
4 Ordinance of the Minister of Health of 5 October 2017 on the detailed treatment of medical waste (Journal of Laws of 2017, item 1975).

72 hours at room temperature and up to 30 days when refrigerated.

A bottleneck in the system

The Polish Central Statistical Office (GUS) has estimated[5] that in 2021 more than 120,000 tonnes of medical waste were created, an increase of nearly 50% compared to the preceding year. The exponential increase in the number of hospitalised COVID-19 patients has rendered the timely collection and disposal of infectious waste a real challenge. Given the practically unchanged number of facilities authorised to incinerate such waste throughout the country (23)[6], the operation of many healthcare facilities was paralysed during the infection peaks, with huge quantities of waste lying in hospital corridors and driveways, as none of the overloaded incineration facilities was capable of accepting it.

It should be emphasised that, in light of Article 27(5) of the Waste Act, a medical waste producer continues to be liable for its waste until it has been rendered harmless by means of thermal treatment. This means that the greatest burden rests on the shoulders of hospitals that are unable to cope with the crisis, not only in organizational terms, but also financially. Increasing energy and fuel prices, staff costs and the growing mismatch between demand and supply have pushed up the price of infectious waste disposal services by as much as 200-300 per cent[7].

A callout from the waste industry

An ad hoc solution to sudden disruptions in medical waste management, as provided for in Article 11i of the Anti-Covid Act[8], allowed infectious waste to be disposed of, in exceptional situations, pursuant to a decision of the voivode, at municipal waste incineration plants, in temperatures of not less than 850 °C. This was obviously only an emergency measure (criticised by some experts for lowering the standards of thermal treatment in a situation of significant risk to public health) that cannot be considered a replacement for a longer-term strategy solving the issue at hand.

The primary focus of the discussion is on the need to build new hazardous waste incineration plants, or to expand and increase the capacity of the existing facilities. The complicated administrative procedures and the resistance of local residents, who simply will not accept a waste incineration plant being erected in their neighbourhood, are the major barriers here. Environmental regulations[9] classify hazardous waste treatment or storage facilities as locations that may always have a significant impact on the environment, meaning that their construction or expansion is associated with lengthy environmental impact assessment studies and public consultations. Similar and equally complex constraints are introduced by the Emissions Act pursuant to which special permits must be obtained for such facilities[10]. At the same time, however, the industry's call[11] for a rapid liberalisation of the law or the enactment of a special law to facilitate the siting of hazardous waste incineration plants clashes with the need to harmonise local regulations with EU law, including the Fit for 55 legislative package just being introduced, which is rather far from relaxing, in any manner whatsoever, the rigours of carrying out environmental impact assessments.

An organisational and economic alternative could involve a more precise and rational classification of the waste generated by healthcare facilities, in particular a reduction in the rushed and often unjustified classification, as infectious, of waste that could be successfully recovered or disposed of by means of less costly methods. That, however, requires more effective management and appropriate training of medical staff.

The issue of infectious medical waste brings into sharp focus the challenges at the intersection of two seemingly unrelated industries – waste and healthcare – with combined effects on the entire socio-economic system. Although the COVID-19 pandemic appears to be gradually subsiding, it should not be ruled out that similar emergencies will arise in the future, and will require complex solutions. There is no escaping them, neither by the legislator nor by hospitals as generators or other participants in the waste management sector.

5 Gospodarka odpadami - Bank Danych Lokalnych ttps://bdl.stat.gov.pl/BDL/metadane/cechy.
6 Draft resolution of the Council of Ministers amending the resolution on the National Waste Management Plan 2022.
7 "Koszty wywozu odpadów zaczynają dławić szpitale", Gazeta Prawna Daily No 211/2020.
8 Act on specific solutions related to the prevention, prevention and control of COVID-19, other infectious diseases and emergencies caused by them of 2 March 2020 (Journal of Laws of 2021, item 2095, as amended).
9 Act on the provision of information on the environment and its protection, public participation in environmental protection and environmental impact assessments of 3 October 2008 (Journal of Laws of 2022, item 1029, as amended) and the Ordinance of the Council of Ministers of 10 September 2019 on undertakings that may significantly affect the environment (Journal of Laws of 2019, item 1839, as amended).
10 The Environmental Protection Law of 27 April 2001 (Journal of Laws of 2021, item 1973, as amended).
11 RynekZdrowia.pl: Mamy-problem-z-odpadami-medycznymi-Czy-rozwiazaniem-jest-duza-instalacja-do-utylizacji?

LEROY MERLIN

Natural gardens in healthcare facilities

We are more and more aware that we need to protect the Earth's resources and we also should reduce our impact on the environment. Urban squares, parks, boardwalks, allotments and community gardens that create space for outdoor relaxation and opportunities to connect with nature are becoming increasingly important. We do not forget that contact with nature also has therapeutic and wellness qualities. Therefore, it is worth creating green enclaves next to healthcare facilities: hospitals, clinics, nursing homes, etc., and when growing them, follow the principles of sustainable cultivation for the benefit of patients and the surrounding nature.

We are more and more aware that we need to protect the Earth's resources and we also should reduce our impact on the environment. Urban squares, parks, boardwalks, allotments and community gardens that create space for outdoor relaxation and opportunities to connect with nature are becoming increasingly important. We do not forget that contact with nature also has therapeutic and wellness qualities. Therefore, it is worth creating green enclaves next to healthcare facilities: hospitals, clinics, nursing homes, etc., and when growing them, follow the principles of sustainable cultivation for the benefit of patients and the surrounding nature.

Even in a small space next to a hospital you can create a garden: grow native vegetables and herbs, plant fruit trees, sow a flower meadow instead of a lawn, collect rainwater, compost waste, use natural pesticides and invite beneficial animals. It does not require a great deal of investment and the benefits are manifold.

Beneficial animals

The garden is not only a colourful flora, but also a diverse and very useful fauna. From the wide range of animals that inhabit our squares and gardens, natural enemies of plant pests are particularly important. Hedgehogs, frogs and toads are very useful in the fight against slugs. Hedgehogs are most likely to take shelter in areas where leaves, hay or branches are gathered, so it is good to leave them a small untidy corner.

The most common visitors are birds. Many species, such as titmice, enjoy feeding on a variety of pests, so it is worth providing them with a safe location and food source. Particularly inviting to winged visitors is a variety of vegetation, including species abundant in seeds and fruits, while additional feeders and boxes will encourage birds to stay in the garden permanently.

Among insects, the best-known natural enemies of the pest are ladybugs, which feed on aphids. The second very important group of insects are pollinators - mainly bees, but also bumblebees and butterflies. Insect houses, which are eagerly populated by pollinators, are a good solution, especially if you grow fruiting plants.

Irreplaceable flower meadow

The natural refuge of insects is a floral meadow, which allows to create a comfortable environment and a rich “canteen” for many species. To prepare a meadow, you can use a ready-made seed mixture, but it will also be created if you single-handedly combine chenopodium seeds with cornflower, chamomile, flax, field poppy and

several species of grasses. A beautiful plant, also valued by bees, is blue phacelia (Phacelia tanacetifolia Benth). The flower meadow can be diversified with other forage plants: purple coneflower and southern globethistle (Echinops ritro) with decorative inflorescences in the form of spiky balls. The second species is a perennial, so it remains in the garden for many years, as do a number of herbs that are also visited by insects: thyme, satureja, oregano, sage, wild thyme, hyssop, catnip or lavender.

It is worth remembering that ready-made mixtures have different compositions, and thus different purposes. They can contain seeds of annual or perennial plants, appropriately selected for the conditions in which the plants will grow, such as dry, sunny, shady areas, etc. Particularly noteworthy are anti-smog plant seed mixtures for urban gardens. So let's adjust the seed mix according to where it is going to be sown. We give up using the lawnmower and enjoy the sight of blooming flowers in our meadow.

Priceless rainwater

We can easily collect rainwater, especially that which runs off the roof of the house, and use it to water plants or during cleaning work. Rainwater collecting is not complicated and does not require expensive installations - in fact, all we need is a rainwater tank set up next to the drain pipe and a gutter or other rainwater diversion element. The water collected in this way can successfully replace tap water, which is most often used to water the garden. It is worth knowing that rainwater is characterized by a slightly acidic pH. Most garden plants tolerate soil with such a pH very well. So it will be suitable for watering the lawn, plants in the garden, as well as those in containers set on the terrace or balcony. With a pump and filter, it can also supply an automatic garden irrigation system.

Natural plant protection products

Using products based on natural ingredients is an excellent and safe way to get rid of plant diseases and control pests. Spraying with products of natural origin does not harm beneficial insects, especially bees, and does not leave a residue on plants. The lack of harmfulness to the environment and the natural origin of these products allow them to be used repeatedly during the gardening season. Natural plant protection products are created, among others, on the basis of plant extracts, such as castor oil, biological preparations, bacterial – based on parasitic fungi, and in the form of sticky boards or pheromone traps. Let's remember that every green patch of space is extremely valuable. Let's use it consciously, preferably in the spirit of ECO.

For more information, visit www.leroymerlin.pl

LUXMED

LUX MED Group on the path towards zero emissions

As the leader of the private healthcare market in Poland, LUX MED Group is also stiving to become the industry's sustainability leader. Being a medical company, we feel responsible for public health and are aware that no one can be healthy without living in a healthy environment. We have set ourselves a goal of reaching zero emissions by 2040 in all of our business areas and reducing scope 1 and 2 greenhouse gas emissions by 40% by 2025, compared to 2019. We are at the beginning of this path. To effectively pursue our objectives, we started calculating our carbon footprint and introduced sustainable solutions in various operational areas – from simple changes to the streamlining of our operations.

Energy from RES

The healthcare sector is responsible for approx. 4.5% of global CO_2 emissions, and more than half of emissions generated by that industry are related to the use of electricity. To minimize our carbon footprint and, consequently, the negative impact on the environment, LUX MED has started purchasing electricity from renewable sources. LUX MED purchases electricity generated entirely from renewable sources taking advantage of the NATURALNIE, ŻE ENERGIA offer by PGE. The company also encourages the owners of office spaces and facilities it leases to use electricity from RES. This issue is an important topic in the negotiations we conduct.

Environmental projects

To stress the connection between human health and a healthy environment, we launched the Healthy Cities campaign. Our intent was to motivate the participants by challenging them to exercise physically, on an everyday basis, to improve their health. Thanks to a contest (with its aim being to make as many steps as possible) in which various teams from different provinces of the country participated, 375,000 trees have been planted all over Poland. Trees of 12 species were planted and it is expected that the forests planted under the project will absorb 13,195 tons of CO_2 within the next 30 years. Overall, 4,000 participants took 375 million steps, covering 280,000 km (which is equivalent to walking around the Earth 7 times). The project also had a symbolic meaning – it was meant to show that every small action matters (regardless of whether your aim is to improve your own health or benefit the environment). It also showed that it is important to be consistent and make a small effort – in both of the aforementioned areas - every single day.

In 2022, we organized the Healthy Cities campaign, engaging 66 Polish cities with county rights and 100 partner companies that accepted the challenge. The winning companies received prizes in the form of tree seedlings, and the cities received funding that may be

40 million
documents processed annually

In peak hours, up to
medical documents
are created every second

In April 2020, telemedicine accounted for nearly
95%
of all consultations

Presently, approx.
50%
consultations are held remotely

earmarked, under their Green Participatory Budgets, for environmental initiatives. We also established cooperation with the Warsaw School of Economics and the prof. Jerzy Hausner Economy and Public Administration Foundation, working on the Healthy Cities Index. We regard the project a long-term commitment to the creation of healthier and more sustainable cities.

Natural raw materials

LUX MED uses 70,000 100-meter rolls of medical sheets per year. The standard material used in the sheets is cellulose, which is usually obtained from coniferous trees. To reduce the consumption of natural materials, the company decided to test medical sheets made from a mixture of recycled paper and cellulose. After testing the new products at the outpatient clinics and hospitals operated by LUX MED, it was established that the only difference compared with the previous version was the shade of white. As of August 2021, sheets made of waste paper and cellulose were introduced as the standard solution at all LUX MED facilities. It was found that, in addition to the environmental benefits stemming from the reuse of materials, sheets with an additional waste paper contents were also 10% cheaper than those made exclusively from cellulose.

Digitization of documents

The LUX MED Group strives to increase the share of its digitized medical documents – IT systems currently process more than 40 million documents per year, most of them solely in electronic form. Such an approach allows us to reduce the cost of printing and archiving paper documents and eliminates the costs of transferring the hard copy originals of medical documentation between different service provision locations.

Telemedicine is another area contributing to digitization. The transformation of the healthcare model observed during the COVID-19 pandemic has produced - thanks to the significant increase in the share of telemedicine consultations - a permanent effect. Currently, 45% to 55% of all consultations are held remotely. The introduction of this model eliminates the need to transport patients to the medical centers (diminishing congestion at parking lots) and reduces the wear and tear of building infrastructure.

Hybrid fleet

To help protect the environment, LUX MED has decided to replace its entire vehicle fleet, over the next few years, with hybrid vehicles. The new fleet will be made up of Toyota models. By the end of 2022, they will account for more than 60% of the entire fleet. In addition to reducing harmful emissions, the increased presence of hybrid vehicles on the roads will also reduce road traffic noise. Vehicles with a hybrid drive have a positive effect on the acoustic environment, particularly in cities. The economic aspect is important as well: the operating costs of hybrid vehicles are reduced due to their lower fuel consumption and maintenance costs.

Lighting and air-conditioning

To reduce electricity consumption at LUX MED facilities, we systematically replace the existing light sources with LED lamps and install new, more efficient air-conditioning units. That allows us to reduce electricity consumption by approx. 61.5% per annum in the case of the air-conditioning units and by approx. 45% in the case of lighting systems.

PHILIPS

PHILIPS

Digitalization and Latest Technologies for Sustainable Hospitals

Over the recent years, digital technologies and data centers have been redefining almost every aspect of our life. The same applies to the healthcare sector, where digitalization has become one of the key trends opening up new opportunities and enabling the transition to more sustainable healthcare models. Climate change is one of the areas impacted by digitization as well. Digital transformation can help reduce the carbon footprint in healthcare through more effective utilization of finite resources (energy and materials). Although the development of information and communications infrastructure also increases the carbon footprint, research indicates that resource savings unlocked by digital technologies outweigh the increase in the footprint caused by the rollout of that technology.[1] This is notably because:

- Digitalization involves "dematerialization" and allows to achieve the essential goal of a circular economy, i.e. delivering maximum value while using minimum amounts of resources. This is best exemplified by medical apps enabling us to use everyday devices, such as tablets or smartphones, for computing and/or user interfacing, thus mitigating the demand for dedicated devices and also contributing to decreasing amount of waste electrical and electronic equipment.

- Sustainable software design processes may reduce the amount of energy consumed by the digital infrastructure by 30% to 90%.[2]

- Digital solutions have an impact on optimizing the performance of hospitals in different areas, e.g., by substantially reducing the number of inpatient procedures. This also indirectly contributes to a reduced carbon footprint.

Below is an analysis of specific digital solutions contributing to hospital sustainability.

1. Hospital in the cloud

Migration to the cloud allows to reduce the number of local servers used. Additionally, the choice of the right software can generate additional energy savings. The power usage effectiveness (PUE) of an average data center equals 1.7, whereas in the cloud industry, the average PUE is 1.2.[3] In short, fewer local servers + a more efficient cloud server = lower energy consumption. Research shows that software customized to be cloud-native rather than run on local servers is capable of increasing the reduction of carbon emissions to 98%[4].

Philips Case Study

By moving Philips Electronic Medical Records and Care Management to the cloud, Philips was able to save on the IT infrastructure used and reduce CO_2 emissions by 15 metric tons compared with the on-site system.

2. Telemedicine

Rozpatrując wpływ cyfryzacji na dekarbonizację opieki When analyzing the impact that digitalization processes have on decarbonizing medical care, the growing role of telemedicine cannot be ignored. Remote care and interactions between patients and caregivers require less travel, thus leading to a reduction of CO_2 emissions. The role of telemedicine can be illustrated by the example of a US medical facility which reported a hike in the number of telehealth visits by 108.5% in 2020. Simultaneously, a drop in greenhouse gas emissions generated by transporting patients to and from in-person visits was observed. Thea amount of greenhouse gas emissions saved was equal to that generated annually by 1,200 homes[5].

According to recent data, up to 40% of all patient visits will be held remotely by 2030[6]. Such remote interactions may reduce the need for outpatient attendance. This, in

1 Accenture #SMARTer2030 (2015). ICT Solutions for 21st Century Challenges.
2 https://www.networkworld.com/article/2861005/energy-aware-software-design-can-reduce-energy-consumption-by-30-to-90.html.
3 Cloud Computing, Server Utilization & the Environment | AWS News Blog (amazon.com).
4 The Green Behind the Cloud | Accenture.
5 Why telehealth is a weapon against climate change (beckershospitalreview.com).
6 Accenture #SMARTer2030 (2015). ICT Solutions for 21st Century Challenges.

turn, will lead to hospitals becoming highly specialized entities, performing only the most complex treatments and procedures. The higher number of patients treated outside hospitals will contribute to reducing consumption of materials and energy, and will eliminate travel.

The use of integrated telemedicine systems in hospital care (for instance teleICU) improves patient outcomes, shortens hospital stays and reduces readmissions. Philips data from the rollout of the VitalHealth platform at one of the hospitals in the Netherlands has demonstrated that by integrated telemedicine systems have reduced unnecessary hospital admissions by 30% and mitigated reoperation rates by 74%. This has already proven to have a positive impact on hospital decarbonization, additionally improving patient comfort and optimizing medical staff's working hours. However, further research is needed to prove a link between the amount of time spent by a patient in hospital and the carbon footprint generated. All stages of the process, from diagnosis to discharge and rehabilitation, must be reviewed in order to implement new solutions capable of minimizing adverse environmental impacts.

3.

Digital medical records and interoperable information systems

Undoubtedly, digitised medical records allow to reduce the amounts of paper used and, thus, curb deforestation. Additionally, interoperability of information systems provides quick access to medical data, regardless of when and where such data is recoded and stored. The implementation of such systems helps prevent multiple repeated diagnoses or duplicated testing. This, in turn, not only contributes to savings for the system and ensures a more consistent patient care, but also indirectly reduces the carbon footprint by reducing IT processing times or eliminating patient travel associated with repeated medical procedures.

SUMMARY/ EXPERT COMMENT

„Digital transition is one of the key transformations needed to achieve the Sustainable Development Goals. Suitably designed digital solutions benefit not only the climate, but also provide a range of other socially positive impacts, such as improved performance of medical facilities or higher quality patient care. Being aware of all those links is essential, as rolling out the concept of a digitally-enabled Green Hospital provides an opportunity to usher in a new better, healthcare system,"
says **Michał Grzybowski,** CEO of Philips Poland.

Sustainable Medical Equipment

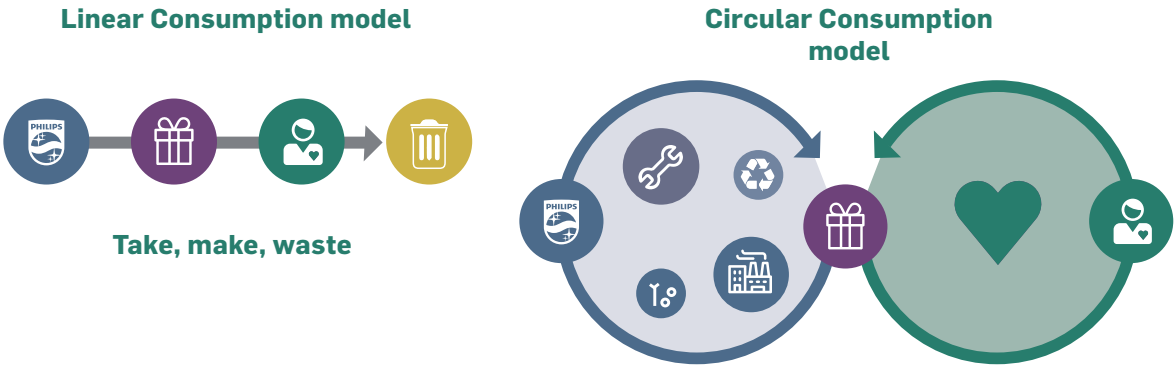
INTRODUCTION: MEDICAL EQUIPMENT VS. THE CIRCULAR CONSUMPTION MODEL

Nearly 100 billion tons of resources are introduce to the market each year, with only 8.6% of that amount being recycled and reused.[1] The current consumption model is based on mass production of goods, their fast sale, time-limited use and disposal by the end user. This means that valuable resources are being exhausted and end up as waste polluting the environment. Such a Linear Consumption model is what the Ellen McArthur Foundation calls a Take-Make-Waste model (Fig. 1). Importantly, in this model, goods are not the only things that end their useful life in a landfill. All the effort and energy put into manufacturing, marketing, selling and transporting them are wasted as well.

The Circular Consumption model is the opposite. The Foundation refers to it as the Take – Make – Use – Reuse model. When this approach is adopted, products are collected from consumers at the end of their useful life and are refurbished or recycled, as a whole or in parts, and then reused.

The Circular Consumption model (aka the 'closed-loop model') is designed to minimize the consumption of new materials and maximize the lifetime value of products.[2]

Figure 1.



Left hand; TAKE, MAKE, WASTE model where equipment ends on a landfill. In the right hand the Circular Consumption model thrt tries to prevent any equipment from ending up on a landfill.

Circular solutions also contribute to reducing the amount of greenhouse gases emitted while producing and transporting new goods. According to the Circular Cap Report 2021, if circular solutions were applied by twice as many organizations globally, greenhouse gas emissions could be slashed by 39%.[3] The Infuture Institute and its annual Trends Map show that the circular economy is still in the Innovation Zone, with a prospect to enter the mainstream within no less than 5 years.[4] The implementation of this particular model has also been increasingly championed by the European Commission which proposed a new legislative package on 30 March 2022 "*to make almost all physical goods on the EU market more friendly to the environment ... throughout their whole lifecycle - from the design phase to daily use, repurposing and end-of-life*" [5].

1 5 Opportunities of a Circular Economy | World Resources Institute (wri.org).
2 Architecture drivers for Circular Economy | Why sell & forget won't cut it anymore | Philips Engineering Solutions.
3 Circular Cap Report 2021, https://drive.google.com/file/d/1NLEPBOrbAytIl_dm7eqP34JqneOXSp8G/view.
4 Infuture Institute's Trends Map.
5 New proposals to make sustainable products the norm (europa.eu).

The implementation and application of the principles of a circular economy will also become a nearfuture reality for healthcare, with benefits expected for the system as a whole. Reduced amounts of waste and more efficient resource management practices, as well as a smaller carbon footprint all add up to a healthier environment. A healthier environment, in turn, leads to improved public health. Those two things are interrelated. According to WHO, ambient pollution itself contributes to 4.2 million premature deaths worldwide each year.[6]

It must also be stressed that a circular economy stimulates economic growth and creates new jobs. It is estimated that the implementation of a circular economy on the European scale by 2030 would increase GDP by 6.7%.[7] **For medical facilities, circular solutions provide an opportunity to leverage high-quality and advanced technologies while ensuring costefficiency of the healthcare provider's operation and enabling it to better care for the environment.**

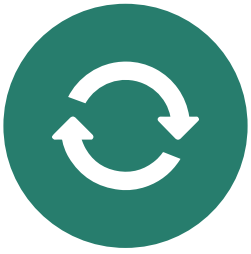
CIRCULAR DESIGN, ECODESIGN AND SUSTAINABLE MEDICAL EQUIPMENT DESIGN: KEY CONCEPTS AND BENEFITS

It is estimated that approx. 80% of all environmental impacts of a given product are determined at the design stage.[8] This means that for the Circular Consumption model to operate effectively, medical equipment must be created in the spirit of Circular Design. The circular design model is distinguished from the conventional approach by the fact that a clear target is set at the outset, with the entire production process, economy and consumption focusing on reusing or reprocessing as many components as possible. When designing a product, you already think about the its lifecycle journey up to and including its disposal. You determine the methods harnessed to refurbish the product, recover it for parts and recycle it. In the case of medical equipment, you rely on smart digital solutions (e.g. equipment performance trackers) and innovative service models throughout the process. To effectively close the circular loop, it is worth thinking early about systems that support the product's useful life, such as takeback and refurbishment programs.

"In addition to its indisputable environmental benefits, a circular economy also helps build a more flexible healthcare system, with access to top quality equipment in various applications. It is important that the awareness of those comprehensive benefits be raised, contributing to the widest possible implementation of environmentally-friendly solutions. At Philips, we run a number of programs that support a circular economy. One of them is Circular Edition, an equipment takeback and refurbishment program under which we thoroughly refurbish, upgrade and quality-test the equipment we take back from customers to ensure same-as-new performance, with less materials than a brand-new system would use along the way".

Michał Grzybowski
CEO of Philips

Circular Design of Medical Equipment:



- Choosing durable and sustainable materials
- Equipment architecture that facilitates the process of cleaning products by creating easy-to-reach surfaces which may be cleaned quickly and repeatedly
- Equipment architecture that allows to easily assess and track performance and is capable of estimating the wear and tear of a given piece of equipment and its parts that require maintenance
- Modular structure for easy repair and dismantling
- Easy-to-recycle equipment and components

6 Global Health Care Outlook 2022 Deloitte, gx-health-care-outlook-Final.pdf (deloitte.com).
7 Sustainability Insights (1/2018) | Jakie korzyści niesie circular economy? | Deloitte.
8 EU pushes new 'circular economy' rules for everyday items – EURACTIV.com.

In addition to circularity, sustainable medical equipment design addresses such aspects as **energy efficiency, reduced use of hazardous substances or packaging components.** Such a comprehensive approach falls within a broader category of **EcoDesign**.

Figure 2.

Energy

Energy consumption is often the single most important factorvin determining a product's lifecycle environmental impact. By improving the energy efficiency of a product, we can reduce its energy consumption and carbon footprint.

Substances

Products are made using a range of substances, some of which may have an impact on people's health or the environment. By minimizing or eliminating the use of hazardous sybstances, we can reduce our products' health and/or environmental impact.

Packaging

Material, weight and volume reduction, along with smart material choices (e.g. from recycled and/or certified renewable sources, 100% recyclable, easily, separable), helps minimize resource consumption and environmental impact over the life cycle of the packaging. At the same time, designing packaging to be reusable, recyclable or compostable also ensures it is circular economy-ready.

Circularity

Circularity refers to the potential of a system, product or component to contribute to the circular economy. It is calculated by assessing environmental performance over multiple life cycles, taking into account, for example, the recovery of materials and their reuse in new products. Upgrading, serviceability, refurbishment, spare parts harvesting, increased recycled content and recyclability, weight reduction, selection of more sustainable materials – these all help to reduce resource consumption. Circularity also includes product lifetime; longer lifetime reduces the resource consumption and transportation emissions associated with the introduction of new products.

Circular equipment intended for medical facilities is characterized by increased operational quality and efficiency, i.e. factors which are of key significance while making equipment replacement decisions. **The purchase of refurbished equipment that has undergone rigorous overhaul and/or remanufacturing processes may generate savings of up to 25% compared to the same, brand-new systems, as shown by the example of Philips products.** Such an approach increases the range of clinical capabilities available at a similar price, simultaneously offering access to same-as-new upgrades[9]. Energy-efficient equipment additionally reduces the facility's operating expenses. With the growing pressure on healthcare expenditure, this is a cost-effective solution that offers better returns on investment.

How to Assess Environmental Impacts of Medical Equipment?

Case Study: COCIR and EcoDesign Initiative and Philips Eco Passports

In order to reduce the environmental impacts of medical equipment, the European Trade Association COCIR, in consultation with the European Commission, established the Self-Regulatory Initiative (SRI) on eco design for medical imaging equipment. Each year, the COCIR SRI Steering Committee applies its complex methodology to a new product group, defining specific use scenarios, assumptions, measurement methodologies and setting an ecodesign target. Philips may serve as a good example of a commitment concerning the COCIR initiative. Based on eco guidelines, Philips prepares Eco Passports summarizing the major environmental benefits of individual products in one or more key categories, such as energy efficiency or circularity.

For more about the initiative, please visit:
Ecodesign Initiative (cocir.org)

9 Refurbished and Remanufactured Medical Equipment Circular Edition Systems | Philips Healthcare

NEW BUSINESS MODELS BASED ON SUSTAINABLE MEDICAL EQUIPMENT

The use of medical equipment that complies with the circular economy principle offers ample opportunities to transform business models. A shift from equipment purchases towards **a service-based business model**[10] where the ownership of a product is not transferred to the user but remains with the company providing the service, is a good example of such an approach. **In this model, the customer pays for a service consisting in making products available for use, and does not pay for the products as such.** A hospital using refurbished magnetic resonance imaging equipment, maintained and upgraded by the manufacturer, may serve as a good example here. Closing the loop when handling medical equipment and delivering machines under service contracts **provides access to innovative solutions at lower prices, simultaneously cutting the initial costs.** That is how other solutions may be promoted as well, such as **sharing of medical equipment by different facilities** in order to distribute the cost between entities with insufficient capital resources.

10 Architecture drivers for Circular Economy | Why sell & forget won't cut it anymore | Philips Engineering Solutions.

Hospital management

The medical sector generates more pollution than shipbuilding or aviation industries. If the world's healthcare system were considered a separate country, it would rank 5th among the largest emitters of CO_2[11]. Such negative results may be contributed, to a large extent, to hospitals which are characterized, in most cases, by high energy intensity, as they emit 2.5 times more greenhouse gases than commercial buildings[12]. This is caused by the fact that the majority of hospitals and other medical facilities have not been designed with energy efficiency in mind. Technical advances also contribute to the increasing share of specialist equipment used which requires additional cooling[13].

What strategies should be adopted and what solutions should be relied upon to reduce the carbon footprint of healthcare facilities?

Responsible and sustainable use of energy and materials is the key to decarbonizing healthcare, and to achieve this objective, we should focus our efforts, inter alia, on the following:

1.

Sustainable partnerships - support of "green organizations," such as **HealthCare without Harm**, and the use of their resources, including tools (e.g., **Climate Impact Checkup**, through which medical facilities can measure, track and manage greenhouse gas emissions), best practices, case studies and expert advice or initiatives (e.g., **Global Green and Health Hospitals**) is crucial for smooth and effective implementation of changes aimed at decarbonization of hospitals. The selection of suitable suppliers (those who are certified, provide services and manufacture their products in accordance with to pro-environmental standards) is equally important. This applies to all vendors – those providing medical equipment, air conditioners and who render catering services. According to studies, as much **as 71% of CO_2 emissions generated by the medical sector come from the supply chain**[14], namely from manufacturing and transportation processes. Prudent planning and smart purchasing decisions taken by individual facilities will contribute to reducing greenhouse gas emission on the macro scale.

The science - based targets initiative is a shared project of CDP (Disclosure Insight Action), the United Nations Global Compact, the World Resources Institute (WRI) and the World Wide Fund for Nature (WWF). The initiative provides companies and financial institutions with a clearly defined path for reducing greenhouse gas emissions. Targets are considered "science -based" (i.e., based on science) if they are consistent with the latest climate research findings and if they contribute to achieving the goals of the Paris Agreement – limiting global warming to well below 2°C compared with the pre-industrial age, and stiving to limit that value to 1.5°C. An increasing number of companies is striving to based their activities on those goals. Philips is a good example of such a company operating in the healthcare industry, as it is already climate neutral (as of 2020) and obtains all its energy from renewable sources.

Read more about the initiative here:
Ambitious corporate climate action
- Science Based Targets

2.

Investing in renewable energy sources, such as solar panels and photovoltaic farms. One such farm was launched in December 2019 in Janów Lubelski as part of the hospital's thermal modernization project. The facility's energy savings generated until December 2021 amounted to PLN 280,000[15]. A similar system is planned to be installed in 2022 by the **Provincial Healthcare Complex Specializing in Lung Diseases and Tuberculosis in Wolica near Kalisz –** one of the 43,000 hospitals and medical facilities worldwide being part of the *Global Green and Health*[16] initiative.

As shown by the examples presented above, a great deal can be done to start reducing the negative impact of medical facilities on the environment. Promotion of the knowledge about the available solutions, and well about the resulting benefits - not only environmental of environmental nature – is extremely important. Regardless of how widely those solutions will be adopted, further

11 Healthcare Without Harm, Healthcare's Climate Footprint report, https://noharm-global.org/sites/default/files/documents-files/5961/HealthCaresClimateFootprint_090619.pdf
12 Information and environmental resources related to healthcare (ecomedsupply.com)
13 Raport Deloitte: Przed nami dekarbonizacja i dalsza cyfrowa transformacja opieki zdrowotnej: MedExpress.pl
14 Healthcare Without Harm, Healthcare's Climate Footprint report, https://noharm-global.org/sites/default/files/documents-files/5961/HealthCaresClimateFootprint_090619.pdf
15 Kolejny pracowity rok przed nami – Samodzielny Publiczny Zespół Zakładów Opieki Zdrowotnej w Janowie Lubelskim (szpitaljanowlubelski.pl)
16 Szpital w Wolicy pionierem w wykorzystaniu zielonej energii w obiektach medycznych w Polsce - rp.pl

detailed research is needed focusing, for example, on the relationship between the time a patient spends in the hospital and their carbon footprint. Based on such analyses, consistent and widespread systems for monitoring CO_2 emissions generated by specific medical facilities should be created. Technology companies and the digital solution they provide will continue to play an increasing role in the future decarbonization of healthcare systems. Government introduced regulations, such as those specifying greenhouse gas emission targets, will be of key significance as well.

How to adopt a holistic approach to sustainability of hospital operations?

The efficiency of work of each hospital and of its human resources, as well as its carbon footprint depend on the facility's technical infrastructure and sustainable workflows, i.e., efficient patient triage procedures, digitization of hospital records, planning and managing technical aspects of operations while taking into consideration the entire life cycle of specific pieces of equipment (including warranty and post-warranty periods, modernization, improvement or expansion plans). Sustainability of hospital operations is impacted, to a no lesser degree, by logistics and procurement processes in which work ergonomics principles need to be taken into consideration while designing new facilities or while improving operational efficiency of existing hospitals by implementing lean and low-carbon logistic processes. Sustainability of infrastructure (lighting, heating, water, medical and non-medical equipment) is final element that should be taken into consideration and subjected o standardization or modernization based on suitable audit procedures or professional research. To summarize, a sustainable hospital relies on sustainable workflows and collaboration, sustainable logistics and procurement processes, and sustainable infrastructures. Regulations such as the Regulation of the European Parliament and the EU Council on the disclosure of information related to sustainable development in selected sectors of the economy (SFDR) or the European Commission directive on reporting, by economic operators, of issues relating to sustainable development (CSRD), will continue to stimulate the adoption of sustainable development standards (also by relying on subsidy mechanisms) to boost the competitiveness and attractiveness of entities attaching sufficient importance to sustainability issues.

PST

Projekt Solartechnik

Green-energy hospitals

As many as 50,000 healthcare establishments belong to the Global Green Healthy Hospitals network worldwide. In Poland, only two medical facilities have the status of "green hospitals". One of them is planning to install a photovoltaic system.

2021 was an unprecedented year in terms of the increase in the capacity of solar power generation systems installed in Poland. We reached the position of the second quickest developing European country as far as the increase in new PV capacity is concerned. Renewable energy sources are breaking new records, and during the so-called "long weekend" between 16-19 June of this year, o they accounted, over a period of several hours, for 40-50% of energy supply nationwide.

This year, the energy transition process will accelerate even further, no longer being driven by environmental concerns only. The new and quickly changing geopolitical situation will be an important factor as well.

The need to invest in in-house power generating plants is felt not only by prosumers operating micro-installations, but also by the so-called business prosumers (self-producers). This group has been severely affected by high wholesale energy prices and power distribution fees. Despite a system of relief measures available to energy-intensive industry sectors, many companies and institutions — with hospitals included — continue to suffer the most from severe energy price increases.

Almost every pro-environmental measure brings about tangible economic benefits. All activities benefiting our climate also should be considered as measures promoting our health. Healthy lifestyles and habits and disease prevention practices – all these approaches are cheaper than medical treatments, says Krzysztof Czajka, CSO of Projekt Solartechnik.

When analysing the situation of Polish medical facilities over the past fifteen years, we can see that they are paying increasingly more attention to the thermal insulation of buildings, replacing window frames, insulating walls, modernising heat and ventilation shafts, as well as auditing the efficiency of heating systems, which often leads to replacing electrical appliances with more efficient models which can be operated in a more environmentally friendly manner. Since 2010, we have seen an increased level of investment in heat pump systems and solar thermal collectors providing hospitals with thermal energy. The effects of thermal modernisation have resulted in significant improvements in energy costs. Over a period of eight years, in some hospital, thermal energy consumption has been reduced by up to 50%, generating CO_2 emission savings of 1,000 tons per year[1].

The next natural step for managers of healthcare facilities should be to optimise the prices of utilities, including electricity, as hospitals consume as much energy as manufacturing plants. Large provincial hospitals, even after undergoing thermal modernisation projects, may consume as much as 3,000 MWh per year. Such amounts of energy supplied via the power grid generate up to 1.8 million kg of CO_2 emitted into the atmosphere annually. Meanwhile, even a small 50 kW PV installation is sufficient to save up to 30,000 kg of CO_2 per year.

In order to approach the process of optimising operating costs in a comprehensive manner, Projekt Solartechnik proposes to rely mostly on energy produced by photovoltaic installations (having various physical forms and operated under different ownership schemes).

Electricity generated from freely available solar radiation is not susceptible to such dynamic unit price changes as those affecting energy generated from conventional sources. As the price of energy from these traditional sources is estimated to increase sharply each year, they make it much more difficult to come up with balanced budgets.

The process of selecting an optimal form of solar energy begins with professional advice that is based on the actual energy consumption profile. This allows the client to assess suitability of the tariffs selected, determine the so-called peaks (periods with peak consumption) and specify the preferred capacity of the installation to achieve an optimized energy use profile.

1 Provincial Specialist Hospital in Jastrzębie-Zdrój "Improving the energy efficiency of the hospital". https://wss2.pl/files/images/aktualnosci/lipiec_2016/efektywnosc.pdf

Hospitals consume various amounts of energy, which means that an appropriate form of investment in renewable energy sources needs to be made or that ready-made solutions available on the market need to be purchased.

HOW TO "BRING" GREEN ENERGY TO HOSPITALS?

PV system located in the immediate vicinity (on-site), with a capacity of up to 50 kWp

- the easiest and fastest to implement (within 45 days) no need to apply for permits and approvals
- annual generation of up to 50 MWh. Assuming that all that electricity will be consumed on site, annual
- savings may amount to PLN 40,000.

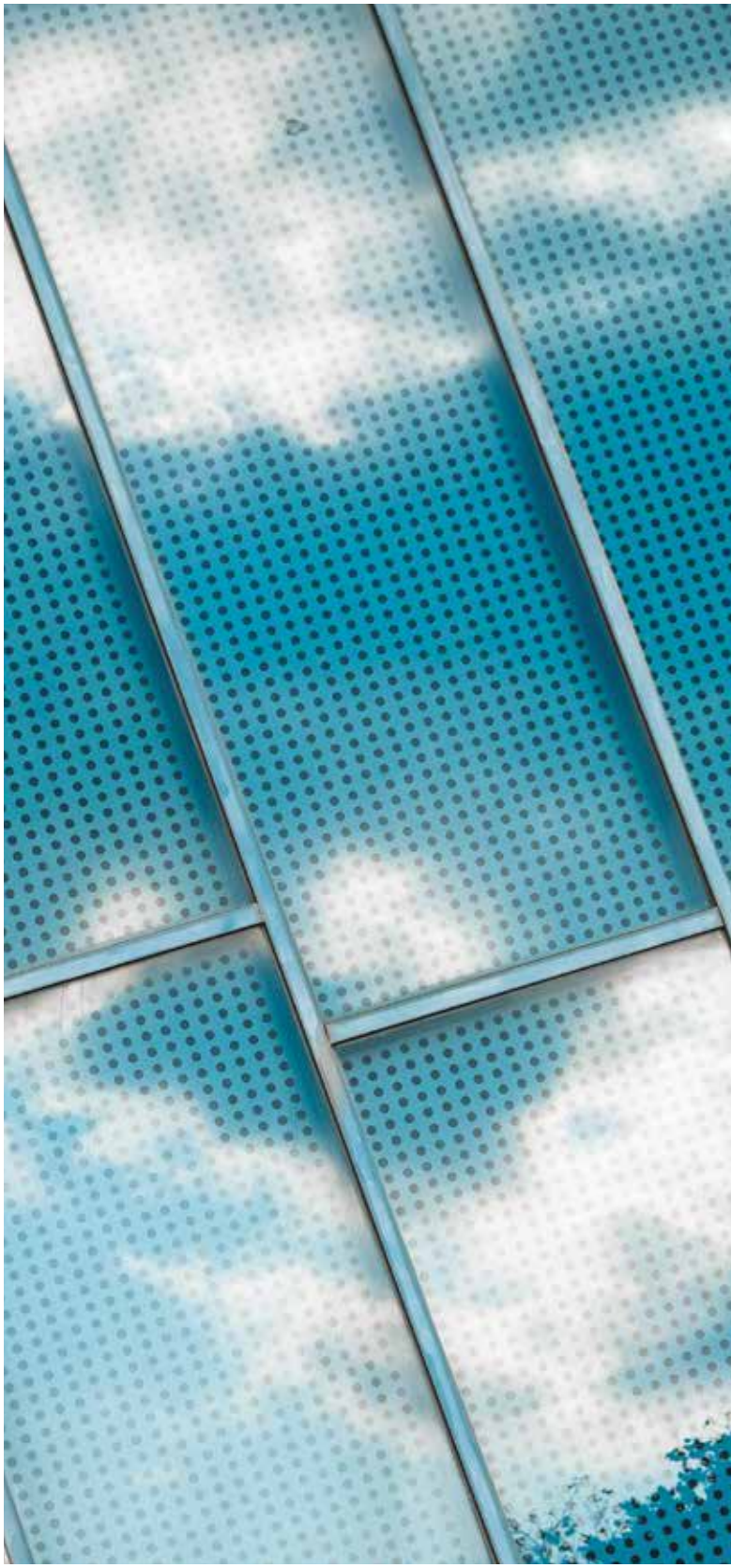
PV system located in the immediate vicinity (on-site), with a capacity of more than 50 kWp

- the capacity of the system depends on: local conditions, results a power demand analysis and the gid connection permit obtained
- implementation of the project should be preceded by an energy consumption audit and by adjusting the system's parameters to the customer's specific needs.

Purchase of a photovoltaic farm that is operated off-site

- it is possible to purchase a photovoltaic power plant or shares in a company operating such farms at various locations all over Poland
- this solution is intended for companies that cannot build their own PV plants in the immediate vicinity
- purchase of energy under the PPA (Power Purchase Agreement) formula
- the formula is intended for entities willing to use cheaper, more environmentally friendly power generated by photovoltaic farms, without having to invest in their erection
- PPA offers savings and greater price stability than in a scenario in which energy is purchased conventionally, from the grid.

The selection of a suitable solution for purchasing and producing electricity is the main factor determining the end user's profit levels. With a well-executed energy audit, a hybrid electricity generation solution may be opted for, with its final settlement bringing the maximum added value to the project. Photovoltaic installations should be the last step of the journey towards improving the efficiency of hospitals that began more than a decade ago. In addition to translating into financial benefits, this step should also bring about environmental and climate-related benefits, concludes Krzysztof Czajka, CSO of Projekt Solartechnik.



PZU Zdrowie

PZU Zdrowie medical network

As a healthcare operator caring for our patients on a daily basis, we are guided by a sense of responsibility for the quality of the natural environment - due to its enormous impact on the health of all members the population. When investing in the expansion of the network of PZU Zdrowie facilities, we place a great emphasis on the environmental standards of our buildings. Our new medical centers are located in office buildings erected in compliance with sustainable development principles. In our day-to-day operational and business endeavors, we promote a paperless organizational culture and switch, wherever possible, to electronic exchange of information while communicating with our patients.

Green standard for the location of medical centers

The most recent examples of our projects involving certified buildings include new PZU Zdrowie medical centers in Gdańsk and Łódź. In May 2022, we relocated one of our Gdańsk medical centers to the state-of-the-art Palio Office Park B, which received the Excellent rating in a BREEAM audit. In the certification process, it received the highest score for its sustainable water management solutions. It was also highly rated for a variety of features, including energy efficiency solutions, materials used and the creation of a healthy environment that is conducive to human well-being.

The Ogrodowa Office site at which our Łódź Medical Center is located, also fulfills the highest sustainable development standards. The building was assessed, at the construction stage, for its energy efficiency, use of renewable energy sources, reduction of CO2 emissions and high quality of the indoor environment – receiving an "Excellent" BREEAM rating and the WELL Health-Safety certificate based on the guidelines of the World Health Organization.

Similar solutions have been applied in the following buildings in which PZU Zdrowie medical centers are located: Villa Metro at Puławska Street in Warsaw (LEED certificate), Varso at Chmielna Street in Warsaw ("Outstanding" BREEAM rating and WELL Building Standard) and Pixel at Grunwaldzka Street in Poznań ("Very Good" BREEAM rating).

PZU Zdrowie attaches great importance to the spaces in which our medical centers are located. Not only are they intended to be friendly and comfortable for patients and employees, but they should also play an important role in caring for nature and should be environmentally friendly. Environmental responsibility and socially beneficial activities are an inherent part of the PZU Group's ESG strategy.

Digital signage system

In 2021, we expanded the system of multimedia displays used in our offices and in the shared areas of PZU Zdrowie facilities. More than 30 medical centers are now equipped with a digital signage system. The electronic presentation of content for patients allows us to reduce the amount of paper documents used and the marketing materials produced. A similar role is played by virtual facility guides created for each new project. They constitute an eye-catching alternative to traditional brochures used in the sales process.

mojePZU mobile app

The mojePZU patient platform, available as a mobile app, offers a number of functionalities for patients taking advantage of PZU Zdrowie services. These include, for instance, the ability to receive medical documentation in electronic form. The app allows referrals, prescriptions, test results and medical recommendations created after a doctor's appointment to be accessed from a single source, without the risk of misplacing any documents. Elimination of printed documents is another important advantage offered by the app.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Healthy, sustainable healthcare facilities

The subject of sustainable healthcare buildings is extremely complex because of the wide and complicated spectrum of issues involved. In Poland, he majority of hospitals are legacy institutions, and the changes that may be introduced are limited to simple modernization projects (e.g. adding an insulation layer or replacing windows).

The standards introduced by sustainable development--based requirements seem, at first glance, to be discouraging and cost-intensive. However, by analyzing the goals that the hospital should strive to achieve (Figure 1) and by assessing the requirements of multi-criteria certification programs, we are able to specify the scope of the changes that should take place at healthcare facilities. Green Building Certifications (e.g. LEED, BREEAM, WELL) are a structured and multi-criteria set of technical, functional and material-related requirements. In the absence of national technical regulations, they are the ones that provide a good reference point for assessing sustainability of buildings.

Figure 1.

The goals of a "green hospital":

1. Reducing your carbon footprint
2. Reducing energy consumption
3. Reducing water consumption
4. Improving indoor air quality
5. Controlling infection rates
6. Reducing operating costs with a particular emphasis placed on
7. Improving the health and wellness of patients and staff

LET'S MAKE SURE THAT THE TERM "HEALTHY HOSPITAL" IS NOT AN OXYMORON.

Reduction of carbon footprint and energy consumption. The design of a new building or a major renovation project involving existing structures should take into consideration both the facility itself and its maintenance costs borne through the entire life cycle. Therefore, it is extremely important to perform a life cycle audit to analyze the potential of renewable energy sources. CO_2 neutrality should also be supported by "classic" solutions contributing to the reduction in operating costs: e.g. installation of motion sensors indoors, reduction of the heat island effect outside of the building or using passive architectural solutions, such as shutters, etc.

Reduction of water consumption.
A hospital is a facility that consumes very large amounts of water. Therefore, the use of flow-reducing faucets, gray water systems or rainwater collection installations should be taken into consideration.

Air quality is the most technically complex topic due to the specifications and separate regulations applicable to hospital buildings. Three aspects related to air should be addressed: the amount of air exchanged in rooms, its quality (content of harmful chemical compounds and microorganisms) and the ability to control the flow of air. Infection control is an inherent feature of hospitals. In order to control the spread of microorganisms (bacteria, viruses or fungi), a suitable HVAC system is used in most use cases (the topic is extremely extensive and interesting), but “elimination” of the adversary is the most effective weapon (such an approach is only possible when combined with flexible functional and spatial solutions), especially when combined with strict hygiene and cleaning procedures.

Operating costs are reduced automatically when water or energy consumption decrease. Here, a precise schedule of technical inspections is extremely important.

Improving the health and wellness of patients and staff.
In order to improve the health of patients, many dedicated solutions are used in certification procedures (Table 1). It should be noted, however, that in addition to strictly technical measures, solutions that affect our mental state or foster the regeneration rate of the body may be used as well. The proper use of colors in the room, adjustment of wall reflectivity factor, introduction of biophilia inside the building, or taking care of

acoustic comfort are some of the approaches that may be relied upon. Green areas where patients and staff can rest and recover are extremely important too. Such places should be accessible (for example, for people in wheelchairs or with reduced mobility) and their primary goal is to reduce stress levels. In the case of existing facilities, considerable limitations are encountered resulting simply from the lack of space outside the building, with every single square meter of space being usually occupied by parking spaces or hospital infrastructure. Green roofs or terraces are a very good solution in such a situation, as the eliminate, almost "by the way", the effect of a heat island and improve water retention capabilities.

Marta Promińska
Director of Project Coordination
and Green Building, Strabag

Table 1.
List of credits in LEEDv4 BD+C certification dedicated to healthcare facilities.

CATEGORY	PRQ. - PREREQUISITE (OBLIGATORY), C - CREDIT (OPTIONAL)
	Prq. Integrative Project Planning and Design
Sustainable Sites	Prq. Environmental Site Assessment
	C. Places of Respite
	C. Direct Exterior Access
Materials and Resources	Prq. PBT Source Reduction- Mercury
	C. PBT Source Reduction- Mercury
	C. PBT Source Reduction- Lead, Cadmium and Copper
	C. Furniture and Medical Furnishies
	C. Design for Flexibility

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Renewable Energy – a Way to Reduce Hospital Operating Costs

Rising costs of heat and other utilities relied upon for generating thermal energy in hospitals are a compelling argument to look for new, cheaper sources.

Renewable energy sources include: geothermal energy, wind energy, solar energy or the energy of flowing water, for example in a river. Waste heat contained in solid, liquid and gaseous waste should also qualify as a low-cost heat source.

All of these energy sources have their specific advantages and disadvantages. For example, geothermal energy requires that deep boreholes be drilled and is characterized by significant variability in the physical and chemical parameters of thermal water. This means that high investment costs are required. Solar energy, in turn, is available over short periods of time (on sunny days only) and its availability at given latitude is difficult to predict.

Simple measures taken to date, such as thermal insulation of buildings or replacement of windows, have resulted in a reduction of heat consumption in hospitals and, thus, in the lowering of associated operating costs. However, not many additional opportunities are available in this specific area. Further reductions in the cost of heating can only be achieved by decreasing the cost of the heating medium. A number of possibilities exist here: continued progress brings about technological advances resulting from the creation of new materials and technologies. New technological developments are capable of replacing or supporting previously used methods.

This article presents an example of how the heating cost can be reduced through the introduction of advanced heat generation solutions, i.e. technologies that support existing heating systems instead of replacing it with a new installation.

A decision on reducing operating costs by lowering the cost of heating is usually preceded by an analysis of the availability of one's own resources that may be earmarked for this purpose and, above all, of the ability to obtain subsidies for the measures that are planned. Only then do consultations on the course of action begin. When deciding on specific solutions, one shall also consider technical issues that limit the options available or even impose the adoption of specific solutions.

Selecting a Course of Action

In the case of the Regional Hospital in Opole, the process involved taking into account the existing hospital facilities and the measures undertaken previously, such as replacement of doors and windows, addition of thermal insulation layers, patrial modernization of the heating system (with a heat distribution center), etc. The decision was made that the existing heating system and the heat distribution centers should remain in use.

An analysis of the current operation of the heating system including, inter alia, temperature data, made it possible to recalculate the amount of thermal energy that needed to be delivered by the district thermal generation plant (PEC) in order to meet the hospital's demand for heat, and allowed to define a new heating curve for the central heating system.

Based on the recalculated amount of thermal power contracted, a new heat demand peak value was determined and the thermal energy supplier was requested to amend the terms of the contract. The structure of the thermal energy supplier's charges was such that a 44% reduction in the amount of power contracted has led to a decrease in the fixed charges included in the price by approximately PLN 12,000 per month. It should be noted that the contracted amount of thermal power was not corrected after previous modernizations, when thermal insulation had been added or windows and doors had been repla-

ced. Ultimately, a solution relying on solar systems and heat pumps was selected, as such an approach was likely to be subsidized. The type of the heat pumps to be used and the type of the heat source they would rely on had to be decided as well. Two options were available here. The first was based on brine-to-water pumps and a ground-installed collector with vertical probes for extracting heat from the ground. The other was based on water-to-water heat pumps for extracting heat from ground water. According to preliminary cost estimates for a 2 x 150 kW heat pump system that had been proposed, the second option turned out to be cheaper. A test borehole was proposed in consultation with Pracownia Techniczna to determine the groundwater yield in the borehole. The tests conducted showed that the borehole parameters were insufficient for it to be used as a source of heat for two pumps with the combined rating of 300 kW. Therefore, a source relying on vertical probes was selected. The test borehole was intended for future use as a backup source satisfying the hospital's water supply needs.

Detailed Solutions

The analysis and the decision on the course of action have led to the selection of the optimum solution and the implementation of the project that was based on two brine-to-water heat pumps of even higher capacity (180 kW each), combined with vertical probes. The use of higher capacity heat pumps resulted from a source temperature difference. For ground-water source heat pumps, source temperatures would not fall below +8°C, while for ground-probe source heat pumps, source temperatures could fall to approximately +1°C, which required higher capacity pumps to generate the same amounts of heat (and consuming slightly more energy).

An assumption was made that the heating systems should be supplied with maximum amounts of heat from renewable sources and that any additional heat required would be purchased from the district heating network. The capacity of the heat pumps was determined on the basis of the characteristics of central heating systems. Solar thermal collectors were only used to generate hot water.

In addition, recoverable waste heat was harnessed to improve the efficiency of the heat pump system. The air conditioning system fed by a compressor unit was shut down and intended as a cold reserve. It was substituted with the 'free' chill produced by the heat pumps.

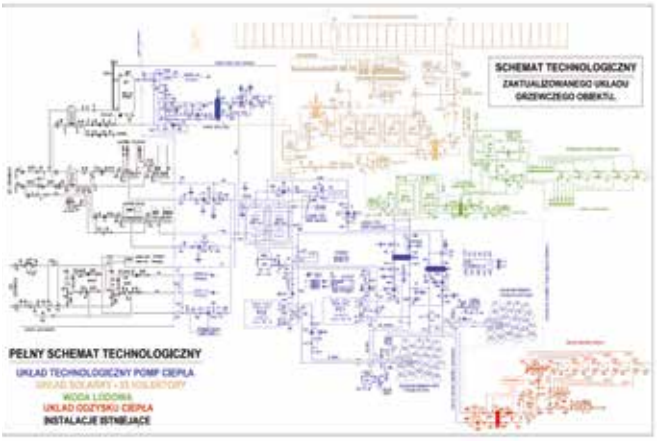
In the proposed solution, the air-conditioning system was to supply heat to the source, increasing efficiency of the brine-to-water heat pump. Thanks to such a solution,

Regional Hospital in Opole

performance of the heat pump was comparable with that of a water-to-water heat pump.

In order to enhance the efficiency of the solar system and to extend the lifespan of solar thermal collectors, the system generating hot water had been designed as a multi-stage solution with the water heating system relying on solar thermal collectors serving as the first stage. Therefore, the heating of cold water would start when the temperature of the heating medium in the solar collectors exceeded +15°C, and these collectors should shut down when the temperature of the heating medium dropped below +15°C. With standard solar systems, such solutions are used when the temperature of the heating medium exceeds the temperature of the water in the storage tank, i.e. a minimum of +45°C.

Fig. 1 shows the individual heating systems to be implemented as part of the project (marked with different colors).



Implementation of the Project

The implementation of the project commenced in 2012 and was concluded in 2013. The heat pump system was being constructed almost in parallel with the solar thermal system. Unfortunately, installation of the heat recovery system had to be postponed until a later date.

The project was implemented based on detailed designs, with the condition of the existing heating systems taken into account as well. For example, the ground-installed collectors were placed in a heavily wooded area and their specific location was based on taking inventory of existing trees.

Due to the size of the plant and in order to optimize its cost, expensive solutions - such as visualization of operation of the heating systems and remote control of the plant - had to be abandoned. Careful planning and detailed designs enabled the project to be drawn up and implemented within the intended timeframe.

Financial and Technical Performance

The analysis was based on the results obtained over one full calendar year, i.e. from 1 January to 31 December 2014. The installation of heat pumps and the hospital's earlier efforts reduced the amount of power contracted from the district heat supplied (PEC) from 2,566 MWt to 1,430 Mwt, i.e. by 44%. Fixed charges dropped by more than PLN 12,000 per month.

The amount spent on the solar thermal system totaled PLN 496,668, with the hospital's own funds accounting for 15% of that amount. The gross cost of constructing 1 m^2 of the solar system's active area was PLN 1,674, and the hospital's share equaled PLN 251.1 per 1 m^2. The cost of installing the heat pumps amounted to PLN 1,781,193.0, with the hospital's own funds accounting for 15% of that amount. The gross cost of 1 kW generated by the heat pump system was PLN 4,638.5, with the hospital's share equaling PLN 695.8 per 1 kW.

What were the energy consumption rates once the systems were up and running? The hospital consumed a total of 11,187.1 GJ of energy (sourced from the district thermal plant and from renewable energy) in 2014, with 3444 GJ of heat generated by the heat pumps and 588 GJ by solar thermal collectors. Thus, the share of renewable energy in the total consumption was 36%. The heat pumps accounted for 30.8% and the solar thermal collectors for 5.3% of energy produced. Moreover, the heat pump system produced approximately 2,583 GJ of chill. Assuming that 50% of this chill was consumed (the system is not metered) and that the average annual COP of the existing system was approx. 2.5, the cost of the electricity saved is approx. PLN 109,150. In 2014 the heat pumps used 347,776 kWh and the solar thermal collector system used 5,169.6 kWh of electricity. In 2014, the hospital saved PLN 348,963 on the costs paid to the district heat supplier (PEC). The cost of electricity was PLN 0.38/kWh.

Summary and Suggestions for Future Projects

The maintenance staff of the Regional Hospital in Opole estimated that the annual savings from the reduction in contracted power and other charges would amount to

approx. PLN 200,000 – with approx. PLN 109,000 stemming from the use of free chill and approx. PLN 200,000 from the installation of cheaper, renewable energy sources. The gross cost of 1 GJ of heat produced by the heat pumps at COP = 2.8 was PLN 37.7/1 GJ (at PLN 0.38/1 kWh). Such a low COP resulted from the fact that the data reflected operation of the full system - including 16 shunt pumps for the heating systems. The actual COP of a single heat pump was approx. 4.5.

With the total investment cost of PLN 2,277,861 (the hospital's share equaled PLN 341,680), there was a 22.35% return on investment within one year, and the hospital's own funds were recovered after 8 months. If the same effects were to be achieved in the following years, the entire cost of the investment would be recovered after 4.48 years, which should be considered a very good result.

Conclusions can be drawn from the implementation of each project and then they can be applied to avoid mistakes in the future, to improve the organization of work or to reduce the costs of similar projects implemented in the future. The results of the project in question demonstrate that the design assumptions made were correct.

The heating systems operate together, complementing each other. If the scope of operation of the systems is expanded and additional amounts of heat from other installation are introduced (e.g. via an air conditioning system - through passive and active cooling), consumption of electricity drops (as the COP of the heat pumps increases). Additional savings are expected after the implementation of a heat recovery system.

Costly solutions, such as full visualization of the heating systems as well as their automated remote control and balancing were deliberately abandoned at the planning and design stages. The decision was supported by the fact that the heating systems were operated by hospital staff who attended to and supervised operation of the systems on a continuous basis.

The systems were designed for operating in low temperature ranges and were intended for future retrofitting with newer solutions, such as fuel cells, as these were then not as widely used as heat pumps. In addition, the project covered only some of the hospital's facilities, rather than the entire building. If a similar project is implemented in other departments of the hospital as well, the cost of operating its heating and cooling systems can be reduced even further.

Where heat pumps can be used in heating systems, with a simultaneous harnessing of chill for air conditioning, very low-cost heating and cooling solutions are created. The operating costs are the key. For example, if a specific price needs to be paid to for a heating medium (for instance hot water with the temperature of 60/50°C), 7/12°C chilled water may be simultaneously generated free of charge. For example, a 100 kW heat pump generates 75 kW of chill as waste.

The fact that the project was implemented in a systemic manner and relied on devices sourced from a single manufacturer was an unquestionable advantage. The new systems proved to be compatible with the existing facilities and there was no need to build additional coupling units. The installed equipment will allow the hospital to introduce full visualization, remote control and monitoring solutions in the future as well. The cost effectiveness of the heating systems installed in the hospital's other facilities may be increased in a similar way. The same approach may be applied at later stages of the modernization of heating systems, for instance when a central system for supervising and controlling the operation of the heating solutions will be designed.

Subsequent years have confirmed that a significant reduction in the hospital's operating costs may be achieved.

Minor optimizations were planned. Unfortunately, due to the Covid-19 pandemic, they have not been implemented yet.

The University Hospital

The University Hospital [Uniwersyteckie Centrum Kliniczne, UCK] has been consequently implementing its buildings modernisation programme. The commissioning of the CIM's [Centre for Invasive Medicine] new main building in 2011 was a landmark event. In 2018, the 1st stage of the CNM's [Centre for Non-Invasive Medicine] construction project was finalised, and the completion of the project is scheduled for this year. New building projects favour the development of advanced technologies. The trigeneration system installed on the roof of the UCK CNM building may serve as a good example here.

Trigeneration consists in a combined generation of three types of energy from primary energy. In the Hospital, the

system generates heat, electricity and cooling by relying on natural gas. Electricity is produced by gas engines and gas-fired generators. Waste heat and flue gas heat are the by-products of the process. They are used for heating process and domestic water. Owing to the application of an absorption chiller, the so-called chilled water is generated and used in air-conditioning units.

The demand for energy of the entire UCK building complex, which comprises 13 buildings, is very high. It can be compared to the amount of energy consumed by a small town. Hence, the need to implement solutions that will help the Hospital reduce its operating costs.

"*Trigeneration is important for the UCK, mainly because it saves electricity and heat purchased from the power grid and the district heating network. It is also used as a source of heat for the domestic hot water system in which proliferation of the Legionella bacteria must be prevented. In addition, it is a safety net for the Hospital should difficulties in supplying the CNM with heat and electricity occur. We are also achieving an environmental effect, as the use of primary energy that is generated by burning gas is more effective, while flue gas emissions are lower*", says Małgorzata Maziuk-Tyda, head of the UCK's Investment and Operation Department.

"*As trigeneration is still a new, costly and 'tailor-made' solution, our decision to choose it was not at all obvious at the beginning. The opinions of external experts, as well as the openness of the institutions that had invested in technologies of this type, were helpful in making the final decision.*"

"*The idea first occured to us several years ago. We wanted to reduce heating costs by insulating buildings, replacing the windows and doors, and we thought about modernising the boiler plant or installing new heat sources. And then we met prof. Dariusz Butrymowicz of the Polish Academy of Sciences. The discussions resulted in a master's thesis by a young student who examined the potential of harnessing cogeneration in our boiler room. When the design of the CNM building was being worked on, we took it a step further and made our dreams true by pursuing the trigeneration approach*", explains Małgorzata Maziuk-Tyda.

"*The project was unique. Therefore, it was difficult to draw on someone else's experience. We visited the landfill site at Szadółki near Gdańsk, an office complex in Katowice, a hotel in Sopot and a hospital in Chojnice. A few locations refused to showcase their installations. Each of these places had its own peculiar features. The visit to Katowice turned out to be most useful, as that is where another commercial building was being erected, with the trigeneration technology relied upon*", she adds.

"*Although the installation of the trigeneration [system] was a new experience for both the UCK Team and the contractor, the intended effect has been achieved. According to the calculations presented in the design, the investment is expected to be set off in full in less than four years.*"

"*More reliable results were obtained after the trigeneration [system] had been in operation for a full year and were confirmed in the following year.*"

"*In 2021, the second part of the CNM building was connected to the system and the energy demand increased. Trigeneration is a system that is more efficient when it is more heavily loaded, i.e. when it has to provide larger amount of electricity and heat. Trigeneration should operate at the upper limits of its capacity; when demand falls below 60% of the system's capacity, its operation is halted automatically*", explains Małgorzata Maziuk-Tyda. The trigeneration system used at the University Hospital' CNM building in Gdańsk became operational on 26 June 2020. It consists of two cogeneration units with the electric power of 401 kW and a thermal output of 549 kW each. It also comprises one absorption chiller. The net cost of the project, according to design estimates, was PLN 3,210,718.76. The investor was the Medical University of Gdańsk. In 2022, the cogeneration units operated for approximately 7,000, generating about 3.8 GWh of electricity and approx. 9.9 GJ of heat. The net operating costs (of consumables) amounted to approx. PLN 206,000.

With the costs and benefits of the system taken into consideration, it tuns out that the construction of the cogeneration solution at the Hospital has proved to be economically justified.

The trigeneration system relies on two Viessmann Vitobloc 200 type EM-401/549 cogeneration units

Lesław Sokólski
„INTECH", Pracownia Techniczna,
in cooperation with Viessmann sp. z o.o.

UNITED NATIONS GLOBAL COMPACT

As a special initiative of the UN Secretary-General, the United Nations Global Compact is a call to companies everywhere to align their operations and strategies with ten universal principles in the areas of human rights, labour, environment and anti-corruption, and to take action in support of UN goals. With more than 12,000 companies and 3,000 non-business signatories based in over 160 countries, and 69 Local Networks, it is the largest corporate sustainability initiative in the world.

UN GLOBAL COMPACT NETWORK POLAND

Is local network with an independent secretariat. It is a project office as well as a local contact and information point for Polish members and signatories of UN Global Compact. UN GCNP identifies challenges and opportunities in the field of sustainable development. Provides practical guidance and promotes efforts to achieve The Ten Principles of the UN Global Compact.

KNOW-HOW HUB

A think-thank and a research center established in 2011 as part of UNDP Poland. Know-How Hub is a knowledge platform serving as a meeting point for various experts who create and implement development projects at the national level. As an independent advisory committee, it is also the Scientific Council to Global Compact Network Poland.

PROGRAM CLIMATE POSITIVE

It contributes to the achievement of UN Sustainable Development Goals, in particular Goal 13 related to environmental protection and climate action, as well as its complementary goals: 6, 7, 9, 11, 12, 14 and 15. Projects under the program include extensive climate-related action, including measures specifically aimed at reducing carbon emissions and developing alternative energy sources, as well as maintaining biodiversity, innovative solutions in transport, agriculture and industry, reducing water and air pollution, supporting green investment and sustainable urban development.

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Know-How Hub
Centrum Transferu Wiedzy

CONTRIBUTORS:
UNGC NETWORK POLAND
Magdalena Nowakowska
Tomasz Czech
Weronika Wilczewska

TRANSLATION
& PROOFREADING:
LIDEX

GRAPHIC DESIGN
& TYPESETTING:
Agnieszka Skopińska
www.rebelzoo.eu

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Network Poland

ul. Emilii Plater 25/64
00-688 Warszawa
www.ungc.org.pl