73 NRP **Sustainable Economy** National Research Programme

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The Sustainable Hospital Revolution: Approaches to reduce the environmental impact

GREEN HOSPITAL

Significance for policy

— The climate impact of healthcare makes up 5.9 % of Switzerland's total environmental impact (Pichler et al. 2019). Hospitals' main environmental impacts do not occur on site, but upstream in the value chain – e.g., indirectly due to purchased goods, which points to the relevance of sustainable procurement. These indirect greenhouse gas emissions are called Scope 3 emissions. The construction of long-living, resource-efficient hospital buildings, the use of renewable energy and plant-based foods, as well as decreasing food waste is crucial for sustainable hospitals.

— Hospital decision makers need a joint platform for an active exchange about successes and failures on the pathway to sustainable hospitals. Applicable associations or administrations should be encouraged to provide such a platform.

— Policy makers are advised to provide conditions that allow hospital management to include sustainability impacts in their decision making. Policies should support the development of sustainability strategies for all hospitals, create more favourable conditions for sustainable procurement, and provide sustainability targets to which the hospitals should adhere.

Swiss National Science Foundation

A hospital is sustainable if its impact on the environment, society and the economy is continuously optimised throughout the whole life cycle.

70 % of overall environmental impact of Swiss hospitals stems from catering, building infrastructure, energy provision and pharmaceuticals (Keller et al., 2021).
Half of Swiss hospitals could reduce their impact by 50 % while providing the same health care services (Roth et al., 2021).

Drivers for sustainable hospitals are

— external financial support for sustainability measures

— an overarching sustainability strategy

— support for decision makers within hospitals, e.g. guidelines

— a joint platform for mutual learning and exchanges on best practice

— a good connectivity to public transport to reduce the use of passenger cars by staff, patients, & visitors

Efficient processes can reduce costs & environmental impact in the area of food with an ordering system that

— cancels meals when a patient leaves or cannot eat for medical reasons (less food waste)

— allows for portion size and meal components to be chosen

— provides more vegetarian options

The area of pharmaceuticals can be improved by

— Timing the preparation of medicines optimally

— Optimizing reuse of partially opened medicines

Approach and Results

We assessed the environmental impact using a life cycle assessment (LCA, see box). In addition, we conducted an efficiency analysis as well as a process analysis.

We collected data with a national survey sent to all 156 acute care hospitals in Switzerland, of which 33 hospitals returned the survey. We analysed the impact of 14 hospital areas: Catering, electricity, heating, building infrastructure, large medical equipment, electronic equipment, housekeeping products, medical products, pharmaceuticals, waste & wastewater, textiles, laundry, water use, and paper use & printing.

We analysed the climate impact as the global warming potential with the method elaborated by the Intergovernmental Panel on Climate Change, and the overall environmental impact with the Swiss ecological scarcity method. In addition to climate impact, the latter method also considers various other environmental impacts, e.g. water & land use, the pollution of water, air & soil, and resource use.

We explored two ways of comparing healthcare services in hospitals:

— Healthcare services provided relative to the standardized revenue.

— Healthcare services provided by one average full-time equivalent (FTE) staff member over the course of one year.

Referring to healthcare provided by a hospital with 1 000 FTE, the climate impact is 3 200 tons CO_2eq and the overall environmental impact 5 300 million eco-points per year. A ton CO2eq equals the impact of driving a passenger car from Zurich to Russia, about 3 000 km. One million eco-point equals a drive from Zurich to Riga, about 2 000 km.

What is a Life Cycle Assessment (LCA)?

A life cycle assessment (LCA) compares environmental impacts in a fact-based and comprehensive way. It includes all environmental impacts that occur during the whole life cycle of a product or a service. This means that to calculate the impact of driving a car, all processes from oil production over road construction to car dismantling are included. LCA and other life cycle–based approaches are key in guiding and monitoring transformation towards a sustainable economy (Stucki et al. 2021).

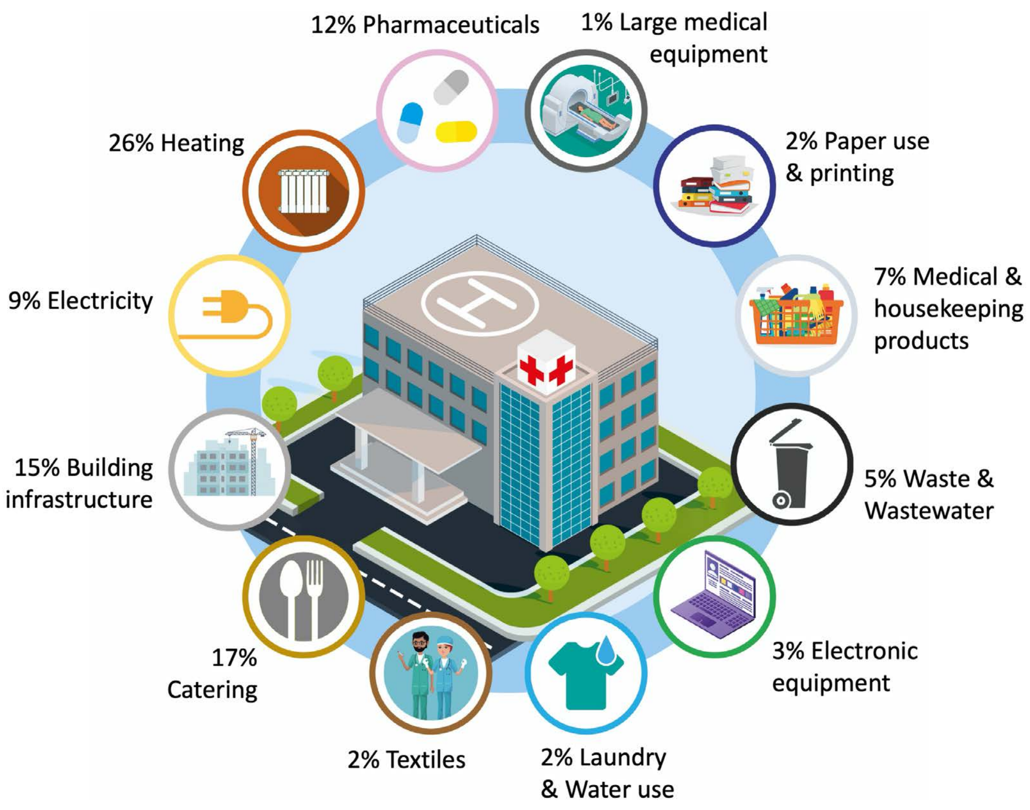

FIGURE 1:
Proportion of the global warming potential of an average Swiss hospital

Environmentally relevant areas

In hospitals, the areas catering, building infrastructure, energy provision and pharmaceuticals together are responsible for about 70 % of the overall impact of the hospital on climate change and the environment. A process analysis showed that from a practical perspective, catering and pharmaceuticals are among the areas with high improvement potential considering process optimization. The production of large medical equipment, housekeeping products & medical products as well as laundry, paper & printing, and water use each contributed less than 4 % to both climate and overall environmental impact.

Process analysis

We analysed processes (see box) in three hospitals and suggested measures to achieve a higher social and environmental sustainability. The analyses showed that material stocks could be significantly reduced, in some wards by more than 50 %. This would reduce the amount of stock that is spoiled and discarded. Another outcome is that integrating a food ordering software in the catering process leads to a reduction of food waste and of untouched dishes that are returned.

Efficiency analysis

We analysed the climate inefficiency with an efficiency analysis that compares the healthcare services of different hospitals with their related climate impact (for details, see box). The areas that have the highest potential for impact reduction combine a high share of global warming potential with a high average inefficiency for the same areas.

Process analysis

According to the German Association for Work Organization, Business Organization and Corporate Development, the process analysis is “a systematic approach to deconstruct a process into its elements in order to gain a better understanding of the whole process, and to identify weaknesses and optimisation potentials. The aim of the process analysis and the subsequent optimization is to continuously and sustainably increase the efficiency of existing business and production processes, as well as reduce the required resource inputs.”

Efficiency analysis

Data Envelopment Analysis (DEA) constructs an efficiency frontier as a piecewise enveloping boundary of the observed data. The main limitation of DEA is that it requires that all relevant exogenous differences are taken into account. All deviations from the production frontier are considered inefficiencies.

Stochastic Frontier Analysis (SFA) is based on a regression approach. The production function and its parameters must be specified, what represents a real challenge. In return, it allows for random errors in the data, i.e. not all deviations from the frontier are inefficiencies.

Potentials for higher environmental efficiency

We measured hospital output by standardizing all hospital revenues with the respective tariffs. This eliminated the problem of adding up outpatient, inpatient and all the other hospital outputs (see Roth et al, 2021). We then estimated the climate efficiency using two methods: the Data Envelopment Analysis (DEA) and the Stochastic Frontier Analysis (SFA) (see box page 5). Estimations with both methods found a large potential for improving the climate efficiency in hospitals. Our analysis showed that half the hospitals could reduce their climate impact by 50 % while providing the same amount of health care services if all heterogeneity are caused by inefficiency.

Areas with high potential

The inefficiency in different areas was calculated as the difference between the median and the maximum efficiency. It is largest for the case of heat, waste & wastewater and medical products.
If, combining the inefficiency with the climate impact, heating constitutes the biggest improvement potential in the hospital sector. An improvement in efficiency by one percentage point would reduce overall annual greenhouse gas emissions by nearly 1 700 tons CO_2eq. A similarly high improvement potential is present for electricity, since the energy mix of a few hospitals is highly carbon intensive. The areas catering, building infrastructure and pharmaceuticals also exhibit considerable sustainability potential.

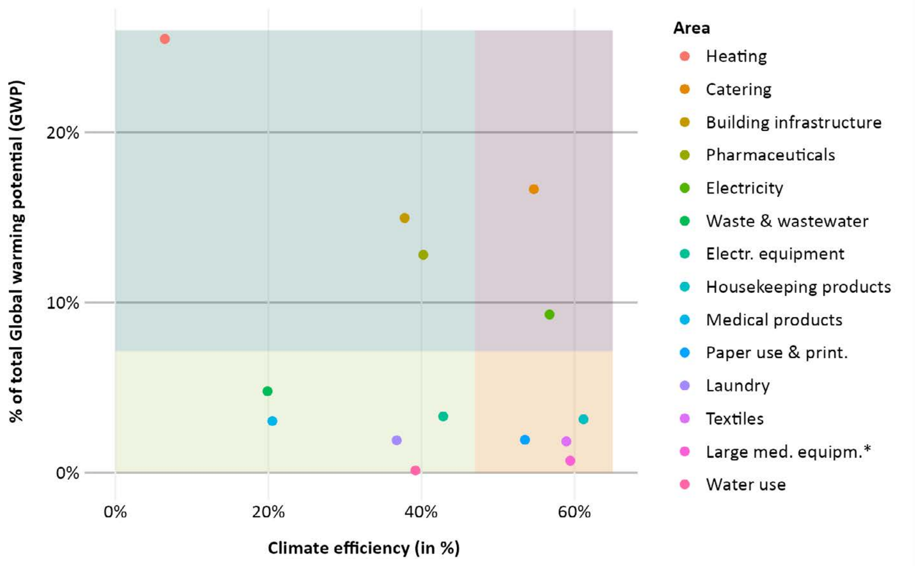

FIGURE 2: Climate efficiency and share of total global warming potential (GWP, vertical axis) of analysed areas reveal their potential for climate improvement in Swiss acute care hospitals. High share and low efficiency show highest potential (top left area), high efficiency and low share show low potential (bottom right area) (n=33, median efficiency using DEA; Roth et al, 2021).

Conclusion

There is high improvement potential for hospitals to reduce their environmental impact, especially in the areas of heat, electricity, catering, building infrastructure and pharmaceuticals.

Hospitals can be supported on their path to sustainability by providing regulatory conditions that encourage them to include sustainability criteria in decision-making.

Short-term effects to improve sustainability can be achieved through changing operational processes, e.g. in the areas of catering or energy as well as material procurement.

Change can be fostered by providing a platform for the exchange of best practices, supporting the development of sustainability strategies, and setting sustainability targets for each hospital. Suitable hospital associations or administrations should be encouraged to provide such a platform.

A common effort of policy makers, hospitals and researchers is needed to reduce the climate impact of health services.

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About NRP 73

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The National Research Programme "Sustainable Economy" (NRP 73) was launched by the federal council with a global budget of CHF 20 million for five years of research starting mid-2017. It funded 29 research projects in different thematic areas such as Circular Economy, Finance, Building & Construction, Cities & Mobility, Forestry, Agriculture & Food, Supply chain, Sustainable Behaviour and Governance. NRP 73 aims at generating scientific knowledge about a sustainable economy that uses natural resources sparingly, creates welfare and increases the competitiveness of the Swiss economy.

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